HiGain

USER MANUAL

H2TU-C-388 List 1 Line Unit
Part Number: 150-2406-01
CLEI: VACHKW0C

Revision History of This Manual

Revision	Release Date	Revisions Made
01	June 6, 2000	Initial release.
02	Jaunary 18, 2002	ADC rebranding

USING THIS MANUAL

The following conventions are used in this manual:

- `Monospace type` indicates screen text.
- Keys you press are indicated by small icons such as Y or ENTER. Key combinations to be pressed simultaneously are indicated with a plus sign as follows: CTRL + ESC.
- Items you select are in **bold**.
- Three types of messages, identified by icons, appear in text.

Notes contain information about special circumstances.

Cautions indicate the possibility of personal injury or equipment damage.

The Electrostatic Discharge (ESD) symbol indicates that a device or assembly is susceptible to damage from electrostatic discharge.

For a list of abbreviations used in this document, refer to "Appendix E - Abbreviations" on page 55.

INSPECTING SHIPMENT

Upon receipt of the equipment:

- Unpack each container and inspect the contents for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to ADC DSL Systems, Inc. Order replacement equipment, if necessary.
- Check the packing list to ensure complete and accurate shipment of each listed item. If the shipment is short or irregular, contact ADC DSL Systems, Inc. as described in "Appendix D - Product Support" on page 54. If you must store the equipment for a prolonged period, store the equipment in its original container.

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OVERVIEW

The HiGain® product family from ADC® is the industry's first practical implementations of High- bit-rate Digital Subscriber Line 2 (HDSL2). ADC products are fully compliant with the HDSL2 standard. Providing full-rate T1 access using just a single copper pair, HDSL2 is a cost-effective solution that offers an open architecture. The open architecture inherent in HDSL2 guarantees interoperability, allowing simple and economic accommodation of network growth. HiGain uses the industry's first HDSL2 chipset (ANSI T1/E1.4 compliant) developed by ADC.

HiGain HDSL2 products provide 1.552 Mbps transmission on one unconditioned copper pair over the full Carrier Service Area (CSA) range. The CSA includes loops up to 12,000 feet of 24 American Wire Gauge (AWG) wire or 9,000 feet of 26 AWG wire, including bridged taps.

FEATURES

The HiGain Line Unit line unit is the Central Office (CO) side of a T1 transmission system.

- HDSL2 transmission features
  - Lightning and power cross-protection on HDSL2 interfaces
  - Full duplex HDSL2 transmission on one pair at 1.552 Mbps
  - Ultra-low wander (Stratum 1 compliant)
  - Grounded loop detection on High bit-rate Digital Subscriber Line 2 (HDSL2)
- Front-panel provisioning features
  - Four-character status display
  - Status Light Emitting Diodes (LEDs)
  - Bantam 210 jack port for RS-232 connection to a maintenance terminal
  - MODE and SEL switches
- HiGain HDSL2 maintenance screens for inventory, provisioning, and troubleshooting
  - DS1 and HDSL2 performance monitoring
  - Non-volatile alarm histories
- Configuration options
  - Selectable DS1 pre-equalizer
  - Bipolar Violation Transparency (BPVT) options
  - Bit Error Rate (BER) alarm
  - Loss of Signal/Alarm Indicator Signal (LOS/AIS) payload alarm option
  - Remote provisioning
  - Selectable loopback activation codes
- Compatible with Double Dual Module Plus (DDM+) high-density shelves
- Payload (PL) and HiGain Generic (HG) loopback source identification
- Network Management and Administration (NMA) interface
- Margin Alarm (MAL) alarm

DS1 is used throughout this document to refer to either the remote unit's DS1 interface or the line unit's DSX-1 interface.

COMPATIBILITY

The H2TU-C-388 List 1 is designed to mount in DDM+ high-density shelves. For a list of compatible shelves see "Appendix C - Compatibility" on page 53.

APPLICATIONS

HiGain systems provide a cost-effective, easy-to-deploy method for delivering DS1 High Capacity Digital Service (HCDS) over a single copper pair. HiGain systems support a multitude of network connections and system models.

- The service is deployed over one unconditioned, non-loaded copper pair.
- With HiGain, conventional, inline DS1 repeaters are no longer required.
- Cable pair conditioning, pair separation, and bridged tap removal are not required.

Each loop has no more than 35 dB of loss at 196 kHz, with driving and terminating impedances of 135Ω. In general, HiGain systems:

- Operate effectively in the same cable binder group with other HDSL2 lines, HDSL, DS1, ADSL, SDSL, POTS, Digital Data Service (DDS), and other transmission schemes.
- Can be used with customers requiring DS1 service on a temporary or permanent basis.
- Provide a means of quickly deploying service in advance of fiber optic transmission systems.

FRONT PANEL

Figure 1 shows the H2TU-C-388 List 1 front panel. Table 1 on page 4 describes the front-panel components. For a list of front-panel display messages, refer to Table 2 on page 5. For pinout diagrams of the H2TU-C card-edge connector and craft port, refer to "Appendix A - Specifications" on page 48.

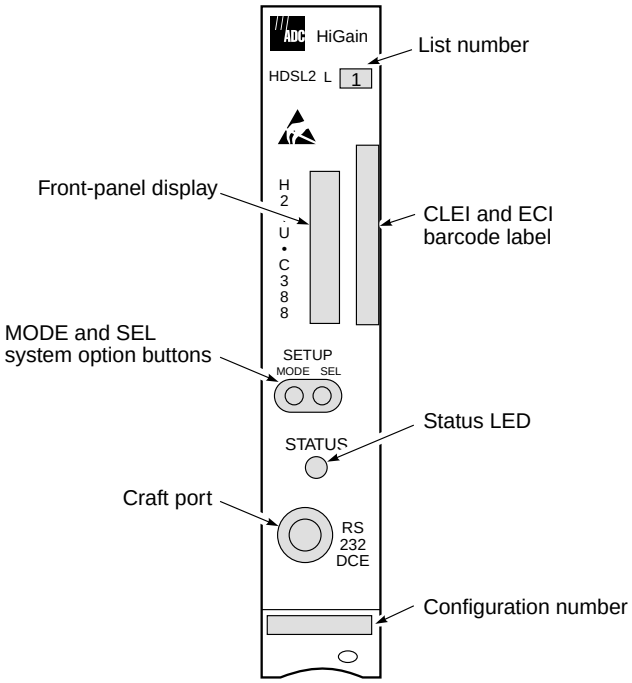


Figure 1. *H2TU-C-388 List 1 Front Panel*

Table 1. *Front-Panel Description*

Front-Panel Feature	Function
Front-panel display	Displays four-character status, provisioning, and alarm system messages. The front-panel display illuminates when power is initially applied. To conserve power the display only remains on for 5 minutes. Using the MODE or SEL buttons reactivates the display and restarts the 5-minute timer. Refer to Table 2 on page 5 for a listing of the four-character messages.
MODE and SEL system option buttons	Permits user options to be monitored and modified without the need of a maintenance terminal. Used to initiate all HiGain loopbacks and to display DSX-1 line parameters and line unit identity.
Status LED	The status LED can report the following conditions:
Off	Line power is off.
Green	Normal operation.
Red	Fuse alarm.
Flashing red	HDSL2 acquisition or system alarm.
Yellow	An H2TU-C-388 List 1 Customer Remote Loopback (CREM) or a Network Local Loopback (NLOC) is in effect.
Flashing yellow	H2TU-C-388 List 1 is in an Armed (ARM) state.
Craft port (RS-232)	Provides bidirectional communication between the unit and an external terminal to allow configuration and performance monitoring through the Maintenance Terminal screens.
CLEI and ECI bar code label	Provides the human-readable Common Language Equipment Identifier (CLEI) code number and the Equipment Catalog Item (ECI) bar code number.
List number	Identifies the list number of the H2TU-C-388 List 1.
Configuration Number	For some products the configuration number may contain either a standalone two or three-digit configuration number or a five- or six-digit warranty configuration number as follows: Digit 1 - Last digit of shipment year Digits 2 and 3 - Shipment month Digits 4, 5, and 6 - Configuration number The configuration number identifies the version of the product. New configuration numbers usually accompany changes in the last two characters of the CLEI code. The configuration number is found on a small label attached to the unit. It is the last two numbers (following the x) of a 13-character part number. For example: 150-1234-01-x**01**.

Table 2 lists the front-panel display messages. The four-character display reports the code of an alarm, loopback, or diagnostic message and, in some cases, is followed by a second four-character message that modifies the first message with a value or current configuration setting.

Table 2. *Front-Panel Display Messages*

Message	Full Name	Description
SYSTEM ALARM MESSAGES		
ACO	Alarm Cutoff	A system alarm has occurred and has been retired to an ACO condition by pressing the SEL button on the H2TU-C front panel.
ALRM	Alarm Condition Exists	A system alarm condition is in effect.
DBER	DS1 Bit Error Rate	A system DS1 BER alarm is in effect and remains in effect until cleared.
HBER	HDSL2 Block Error Rate	A system HDSL2 Block Error Rate alarm is in effect.
LA	Loop Attenuation	Indicates that the attenuation on the HDSL2 loop has exceeded the maximum threshold value.
LAIS	Local Alarm Indication Signal	Indicates an AIS (all ones) pattern is being transmitted from the local DS1 output port.
LLOS	Local Loss of Signal	Indicates that no signal is detected at the DSX-1 input to the H2TU-C. Causes a system alarm.
LOSW	Loss of Sync Word	Indicates that the HDSL2 loop has lost synchronization.
LRAI	Line RAI	Indicates an RAI alarm (yellow) from the CPE with an error-free signal from the line unit or network.
MAL	Margin Alarm	The margin on HDSL2 loop has dropped below the threshold (0 to 15 dB) as set by the operator.
PWR FEED GND	Ground	The HDSL2 loop is grounded.
PWR FEED OPEN	Open	Indicates a line power open condition.
PWR FEED SHRT	Short	Indicates a short between the Tip and Ring of the HDSL2 pair.
PRMF	Performance Report Messaging - Far End	H2TU-R PRM-FE BER threshold has been exceeded.
PRMN	Performance Report Messaging - Near End	H2TU-R PRM-NE BER threshold has been exceeded.
RAIS	Remote Alarm Indication Signal	Indicates an AIS (all ones) pattern is being transmitted from the remote DS1 output port.
RLOS	Remote Loss of Signal	Indicates that no signal is detected at the DS1 input to the H2TU-R. Causes a system alarm.
RRAI	Remote RAI	Indicates an RAI alarm (yellow) from the CPE with errors from the line unit or network.
TUC	Transmission Unit Central Office	Accompanies the HBER, MAL, and LA alarm and indicates that the alarm has occurred at the H2TU-C central office unit.
TUR	Transmission Unit Remote End	Accompanies the HBER, MAL, and LA alarm and indicates that the alarm has occurred at the H2TU-R remote unit.
LOOPBACK MESSAGES		
CLOC	Customer Local Loopback	Signal from customer is looped back to the customer at the H2TU-R.
COLB	Central Office Loopback	Dual loopback at the H2TU-C.
CREM	Customer Remote Loopback	Signal from customer is looped back to the customer at the H2TU-C.
NLOC	Network Local Loopback	DSX-1 signal is looped back to the network at the H2TU-C.
NREM	Network Remote Loopback	DSX-1 signal is looped back to the network at the H2TU-R.
RULB	Remote Unit Loopback	Dual loopback at the H2TU-R.

Continued

Table 2. *Front-Panel Display Messages (Continued)*

Message	Full Name	Description
SMJK	Remote SmartJack Loopback	DSX-1 signal is looped back to the network at the H2TU-R SmartJack module.
DIAGNOSTIC MESSAGES		
A = *xx*	Maximum Loop Attenuation	The Attenuation (A) message appears followed by *xx*, where *xx* is the loop attenuation, measured in dB.
ACQ	Acquisition	The multiplexers of the H2TU-C and H2TU-R are trying to establish synchronization over the HDSL2 loop.
A*n*L	Acquisition *n* Loop	The multiplexers of the two devices are trying to establish synchronization with each other, where *n* is the number of the span.
ARM	HiGain System Armed	Armed to respond to Intelligent Repeater Loop (ILR) codes.
BAD RT?	No Response from H2TU-R	The H2TU-C receives no response from the H2TU-R and all HDSL2 loop conditions are normal. Therefore, the integrity of the H2TU-R or the HDSL2 loop is questionable.
FERR	Framing Bit Error Occurred	Framing bit error occurred at H2TU-C DSX-1 input.
FLDL	Flash Download	Flash download of firmware updates. Contact Customer Service for update procedures (see "Appendix D - Product Support" on page 54).
HES	HDSL2 CRC Error	H2TU-C HDSL2 Loop Cyclical Redundancy Check (CRC) error.
LBPV	Local Bipolar Violation	A bipolar violation has been received at the DSX-1 input to the HiGain Line Unit.
M=*xx*	HDSL2 Loop Margin	Indicates the power of the received HDSL2 signal relative to noise (S/N with respect to 21.5 dB). Any value of 6 dB or greater is adequate for reliable system operation.
MNGD	Managed	The HiGain Line Unit is under control of the HMU-319 Network management unit. In this state, the front-panel craft port and push buttons are disabled.
PWR FEED OFF	Power Feed Off	HDSL2 span power has been turned off by setting the PWRF option to off, or HDSL2 span power has been turned off by use of the A2LB Intelligent Office Repeater (IOR) Power Down code.
PWR FEED ON	Power Feed On	Indicates that the HDSL2 loop is not grounded or shorted.
SIG	Signaling	The transceivers of the H2TU-C and H2TU-R are trying to establish contact with each other over the HDSL2 loop.
S*n*L	Signal *n* Loop	The transceivers of the two devices are trying to establish contact with each other, where *n* is the number of the span.
SYSTEM INFORMATION MESSAGES [(a)]		
CODE *xxxx*	Line Code: AMI or B8ZS	The line code that H2TU-C-388 is receiving at its DSX-1 interface, if the DS1 option is set to AUTO. Otherwise, it mimics either of the other two DS1 line code settings, Alternate Mark Inversion (AMI) or Bipolar with 8-Zero Substitution (B8ZS).
FRM *xxxx*	Frame: SF, ESF, UNFR	Defines the type of frame pattern being received from the DSX-1: SuperFrame (SF), Extended SuperFrame (ESF), Unframed (UNFR).
LATT *xx*	Loop Attenuation	The current loop attenuation threshold setting measured in dB.
LIST *xx*	HiGain Line Unit List Number	The list number *xx*.
MARG *xx*	Margin	The current margin threshold setting measured in dB.
VER *x.xx*	HiGain Line Unit Software Version Number	The software version number (*x.xx*).

(a) System information messages are displayed in scroll mode. To scroll through system information messages, press the MODE button for 3 or more seconds.

INSTALLATION

Upon receipt of the equipment, inspect the contents for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to ADC.

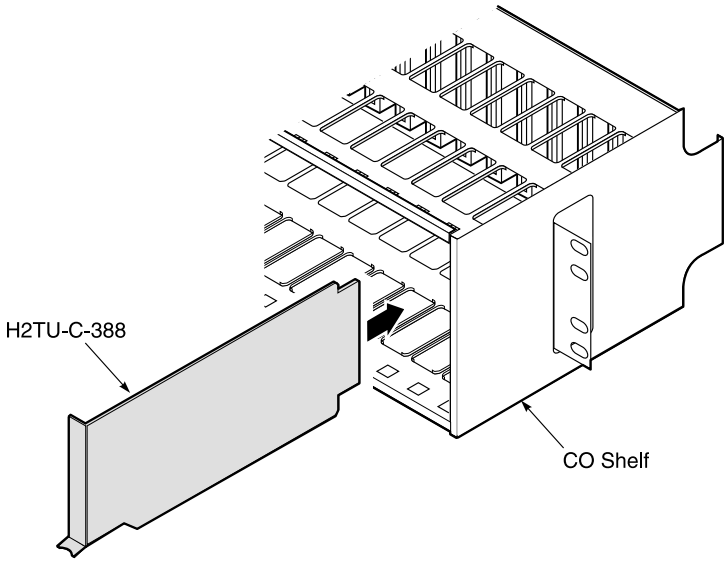


Figure 2. *Installing the H2TU-C-388 into a Shelf*

When installing an H2TU-C in a chassis, be sure to wear an antistatic wrist strap. Avoid touching components on the circuit board.

To comply with the intrabuilding wiring requirements of GR-1089 CORE, Section 4.5.9, the shields of the ABAM-type cables that connect the H2TU-C-388 List 1 DSX-1 output ports to the cross-connect panel must be grounded at both ends.

1 Align the H2TU-C-388 List 1 with the enclosure slot guides, then push the unit in until it touches the backplane card-edge connector.

2 Press down on the H2TU-C-388 front panel to properly seat it.

VERIFICATION

Once the H2TU-C-388 List 1 is installed, verify that it is operating properly. To do this, monitor the following:

- Status LED
- Status messages reported by the front-panel display (see Table 2 on page 5)

Verification without a Downstream Device

If there is no downstream device installed:

1 Verify that the H2TU-C powers up. The front-panel display illuminates and reports status messages. (See Table 2 on page 5 for a list of messages.)

2 Verify that the H2TU-C attempts to communicate with downstream devices (status LED flashes red). Even if a downstream device is not present, the following events should occur:

a The front-panel display reports various four-character status messages.

b The H2TU-C again attempts communication with downstream devices until a downstream device is detected.

Verification with a Downstream Device

If a downstream device has been installed:

1 Verify that the H2TU-C powers up. (The front-panel display illuminates and reports various status messages.)

2 Verify that the H2TU-C attempts to communicate with downstream devices (status LED flashes red). One of the following occurs:

- If downstream devices are successfully identified and the HDSL2 loop synchronizes, the H2TU-C status LED lights steady green. The H2TU-C reports normal margin messages on the front-panel display.
- If downstream devices are not successfully identified, the H2TU-C reports four-character status messages. The H2TU-C attempts communication again and reports four-character status messages. The H2TU-C repeats this cycle until a downstream device is detected.

3 Verify that the remote unit synchronizes normally. The H2TU-C status LED should light a steady green, and the front-panel display should report normal margin messages.

4 Verify that a valid DS1 signal has been applied to the H2TU-C and the H2TU-R.

- If no DS1 signal is being applied to either the H2TU-C or the H2TU-R inputs, then the appropriate DS1 alarms (LLOS or RLOS) are observed on the front-panel display, and the status LED flashes red.
- If a valid DS1 signal is being supplied to the H2TU-C and H2TU-R, then DS1 alarm indications should be absent and the status LED should be a steady green.

PROVISIONING

There are two provisioning methods:

- Use the MODE and SEL buttons on the front panel of the H2TU-C to:
  - Set system options
  - Reset the H2TU-C to its factory default settings for system options
  - Display system option settings (scroll mode)
  - Select system loopbacks
- Use a maintenance terminal (VT100 terminal or a PC running terminal emulation software) connected to the H2TU-C craft port (or to an HMU craft port) to access the HiGain HDSL2 maintenance screens (Figure 3 on page 12). This gives you full access to all H2TU-C status, history, inventory, and provisioning screens.

No dip switches or jumpers are required to provision the H2TU-C-388 List 1 as it contains a non-volatile RAM (NVRAM) which stores the system option settings. System option settings are retained if shelf power is lost or if the H2TU-C-388 List 1 is unplugged.

USING THE MODE AND SEL BUTTONS

Setting Options through MODE and SEL

To provision the H2TU-C-388 List 1 through the MODE and SEL buttons on the front panel:

1. Press the MODE button for 1 second and then release it. The front panel display alternately shows the first system parameter and its current setting.
2. Press the SEL button to step through all possible settings of the selected parameter.
3. After the desired setting has been selected, press the MODE button. This updates the current displayed parameter to the selected setting, then advances to the next configurable parameter. After the last parameter has been selected, a `CONF NO` message appears on the front-panel display.
4. Do one of the following:
   - To cancel the session without saving the requested parameter changes, press the MODE button or do nothing. (After 30 seconds, the display returns to its normal mode without saving the new changes.)
   - To accept the requested parameter changes, press the SEL button. (A `CONF YES` message displays, and the display returns to its normal mode after saving the new changes.)

Resetting to Factory Default Values

All user options for the H2TU-C-388 List 1 (Table 5 on page 17) can be set to the factory default values using the MODE and SEL buttons. To set the user options to their default values:

1 Press the SEL button for 6 seconds until the following message appears:

`DFLT NO`

2 Press the SEL button while the `DFLT NO` message appears.

The message changes to `DFLT YES` indicating the factory default values are now in effect and the display returns to the normal mode.

To terminate the DFLT mode without setting the factory default values, do one of the following:

- Press the MODE button to return to the normal display mode.
- Wait 30 seconds for the unit to return to the normal display mode.

Displaying System Parameter Settings

To scroll through the current settings of all system parameters, press the MODE button for 3 or more seconds. The H2TU-C-388 displays the following parameters:

- Software version number
- List number
- Type of frame pattern received from the DSX-1
- Line code of the signal received from the DSX-1
- All user-configured parameter settings
- Loop attenuation threshold setting
- Margin alarm threshold setting

Loopback Modes

See "Loopback Operation" on page 39 for instructions on using the MODE and SEL buttons to activate loopbacks.

USING A MAINTENANCE TERMINAL

Connecting to a Maintenance Terminal

A miniature, 3-pin, 210 Bantam-type jack on the front panel serves as a craft port and allows connection between the HiGain Line Unit and a maintenance terminal (ASCII terminal or PC running a terminal emulation program). A 210-to-DB-9 adapter is provided with every unit to facilitate the use of standard RS-232, DB-9 cables (see Figure 29 on page 51). Once connected to a maintenance terminal, you can access the maintenance, provisioning, and performance screens.

To connect to a maintenance terminal:

1 Insert the 210-to-DB9 adapter into the RS-232 jack on H2TU-C-388 front panel.

2 Connect an RS-232 cable to the adapter.

3 Connect the other end of the cable to the serial port on the maintenance terminal.

4 Start a terminal emulation program such as ProComm (emulating a VT100 terminal).

5 Configure the maintenance terminal to the following communication settings:

- 9600 baud
- No parity
- 8 data bits
- 1 stop bit
- Hardware flow control to OFF

6 If necessary, press CTRL + R to refresh the HiGain HDSL2 logon screen.

The Logon Screen

The HiGain maintenance terminal screens allow you to monitor, provision, and troubleshoot an H2TU-C-388 List 1 system.

To select a menu from the HiGain HDSL2 logon screen (Figure 3 on page 12), do one of the following:

- Type the first letter of the menu.
- Use the ← → arrow keys to select the menu and press ENTER.

Table 3 summarizes the navigational keys. They are also listed in the onscreen Help menu. Table 4 on page 12 describes the Logon screen menus.

Table 3. *Navigational Keys for the HiGain Maintenance Terminal Screens*

Key [a]	Function
SPACEBAR	Cycle through selections.
ENTER	Activate the current setting or choice, or display a menu.
ESC or F11 (VT100)	Return to the parent menu.
↑ or CTRL + E	Select the submenu or item above the current one, or return to the previous menu.
↓ or CTRL + X	Select the submenu or item below the current one.
→ or CTRL + D	Select the menu or item to the right of the current one.
← or CTRL + S	Select the menu or item to the left of the current one, or return to the previous menu.
CTRL + R	Refresh the screen.

(a) Legacy management units require use of control keys instead of arrow keys.

Most VT100 emulation programs support a print screen option. For Windows-based programs, such as ProComm or Hyperterminal, do the following:

1 Highlight the screen that you wish to print.

2 Click File**, then** Print**.**

3 In the Print dialog box, choose Selection **as the Print Range.**

4 Click OK **to print.**

For printing procedures for other programs, contact the appropriate vendor.

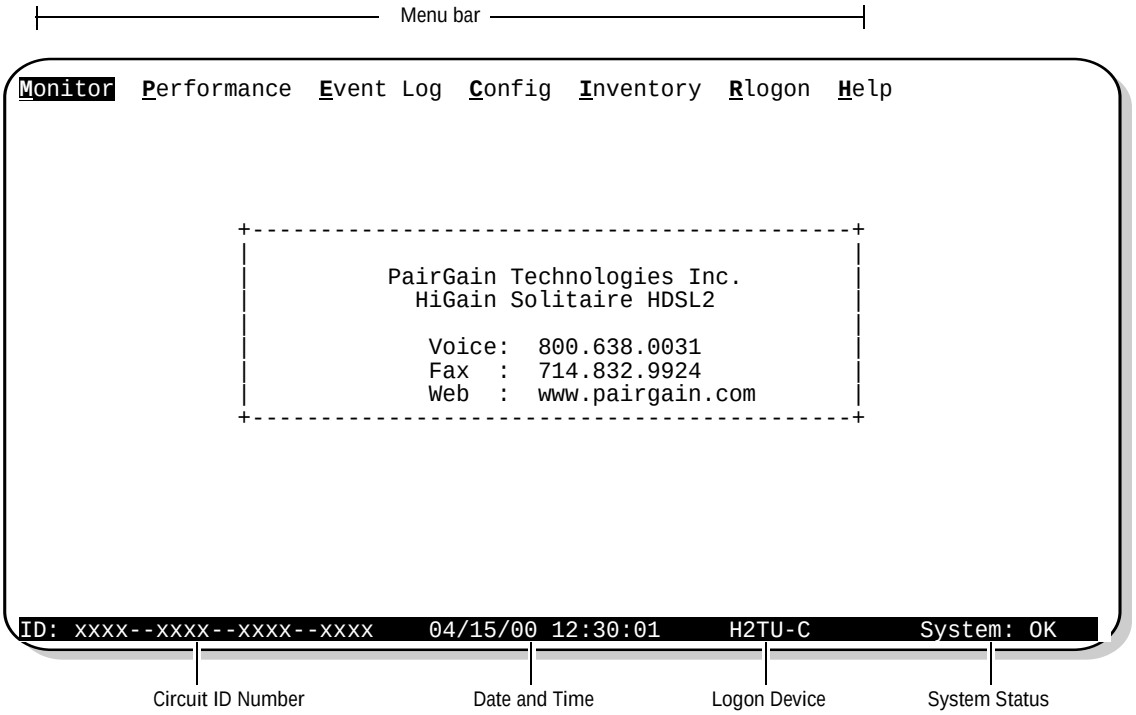


Figure 3. *Logon Screen*

Table 4. *Logon Screen Menus*

Press this key:	To access this menu:	Menu Functions
M	Monitor	Monitors loopbacks and alarms, and provides a graphical representation of circuit activity, including ES, UAS, SES, and line code.
P	Performance	Provides performance and alarm histories for current, 25-hour, 48-hour, or 31-day periods for either the DS1 or HDSL2 interface.
E	Event Log	Identifies the 100 most recent system events and reports the date and time of occurrence.
C	Config	Provides standard configuration options, ADC options, date and time setting, and a reset option (factory settings).
I	Inventory	Provides product information about the various devices that are in the system and lists circuit and device identifications.
R	Rlogon / Rlogout	Remote logon can be performed from the H2TU-C or H2TU-R. The screen displays "**R**logout" when the H2TU-C or H2TU-R is remotely logged on to the other unit at the end of the circuit. To log off the remote unit, press R. "**R**logout" changes to "**R**logon". The unit is now locally logged on until R is pressed again to reinitiate the remote logon.
H	Help	Provides a glossary of terms used in the HiGain HDSL2 maintenance screens, a list of navigational keys, and ADC contact information.

PROVISIONING TASKS

After the HiGain Line Unit is successfully installed, perform these basic provisioning tasks:

1. Set the date and time (see "Setting Date and Time" on this page)
2. Set the circuit ID numbers (see "Setting Circuit ID Numbers" on page 14)
3. Make any necessary configuration changes (see "Configuring the System" on page 15)
4. Clear history, alarm, and event log screens to remove miscellaneous data during startup (see "Clearing the History, Alarm, and Event Log Screens" on page 21)

Setting Date and Time

Figure 4. *Configuration Menu - Date and Time*

1. Type C to select the Config menu.
2. Select **Date and Time**, then press ENTER.
3. Enter the date in the format indicated, then press ENTER.
4. Enter the time in the format indicated (entering seconds is optional), then press ENTER.

Setting Circuit ID Numbers

The Inventory screen provides product information on all units in the system and allows setting of the circuit and unit identification numbers.

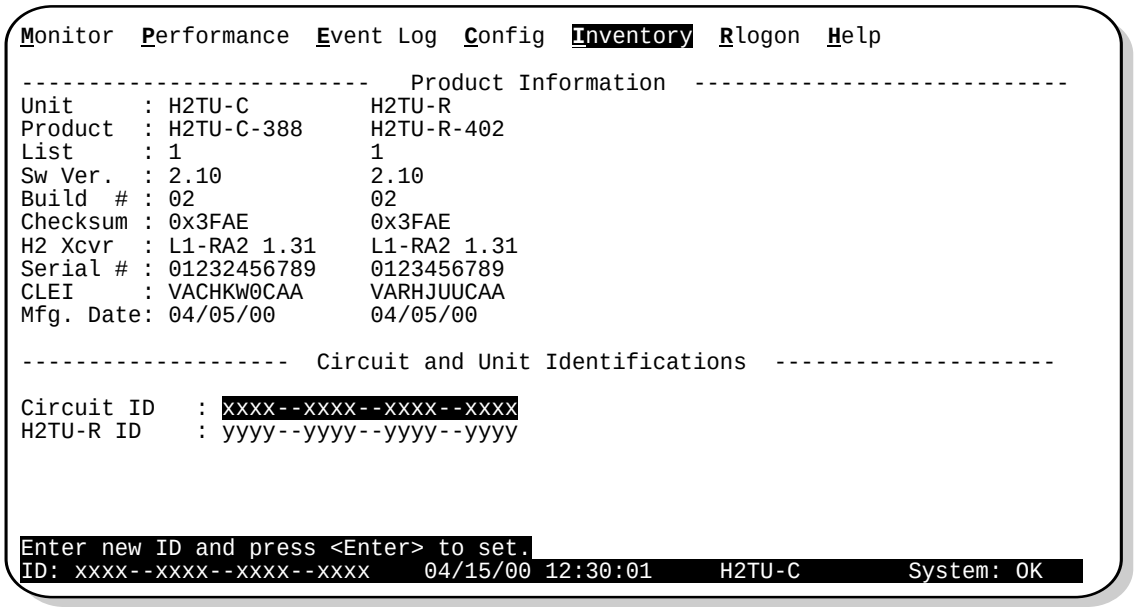


Figure 5. *Inventory Menu*

1. Type **I** to select the Inventory screen.
2. Type the Circuit ID number, then press **ENTER**.
3. Type the ID numbers of all other devices listed in the system, pressing **ENTER** after each entry.

Configuring the System

The Config menu (Figure 6) allows you to make the following types of system configuration changes:

- Standard options (Figure 7 on page 16)
- ADC options (Figure 8 on page 16)
- Date and time (see "Setting Date and Time" on page 13)
- Master clear (see "Clearing the History, Alarm, and Event Log Screens" on page 21)
- Reset to factory default configuration (Figure 9 on page 20)

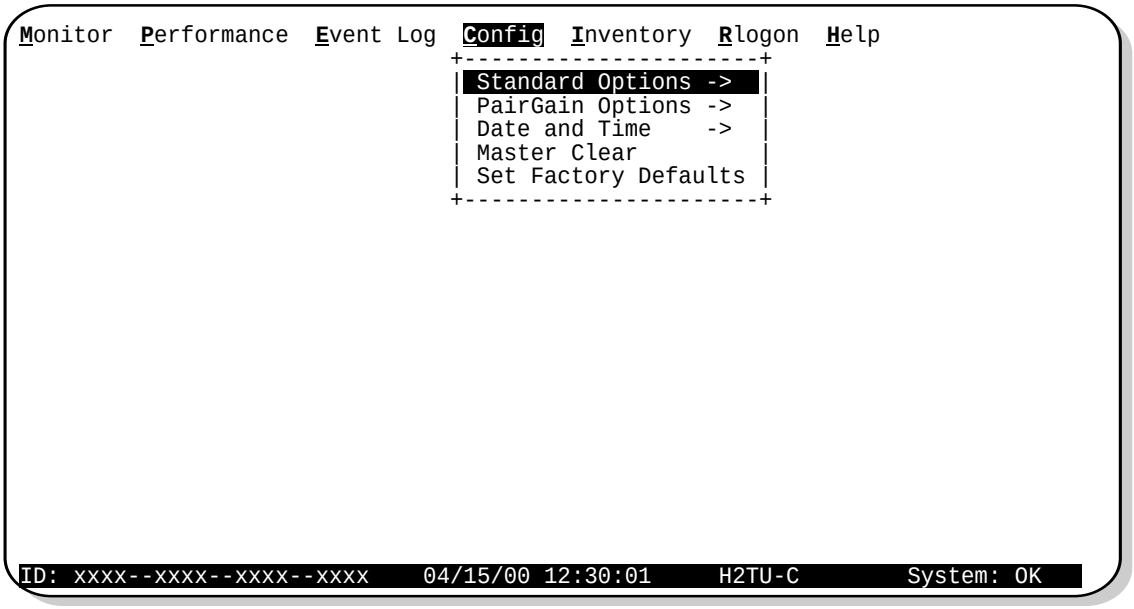


Figure 6. *Configuration Menu*

Making Changes to Standard and ADC Options

Figure 7 and Figure 8 on page 16 show the Standard and ADC configuration options. Standard options are those that are supported by HiGain units when connected to units from other vendors. ADC options are an extended set of options that are only available when using HiGain units exclusively. For a description of each option and a list of possible option settings, refer to Table 5 on page 17 and Table 6 on page 18. To make changes to these options:

1 Type C to select the Config menu.

2 Use the ↑ and ↓ arrow keys to select **Standard Options** or **ADC Options**, and press ENTER.

3 Use the arrow keys to select an option.

4 Press the SPACEBAR to cycle through the available settings for that option.

5 Press ENTER to activate your choice.

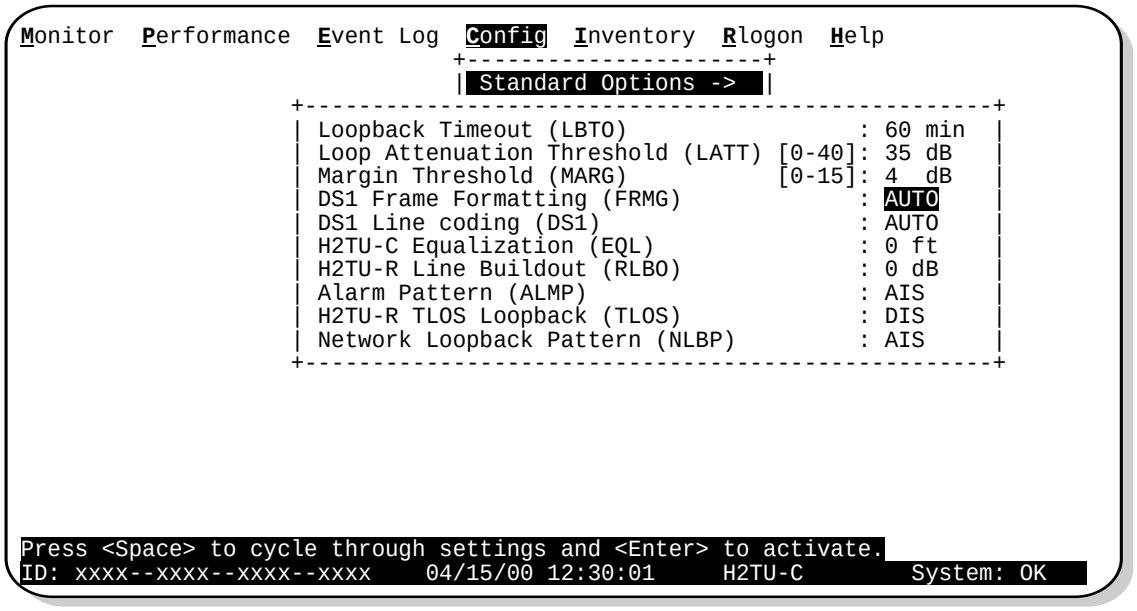


Figure 7. *Configuration Menu - Standard Options (Defaults Shown)*

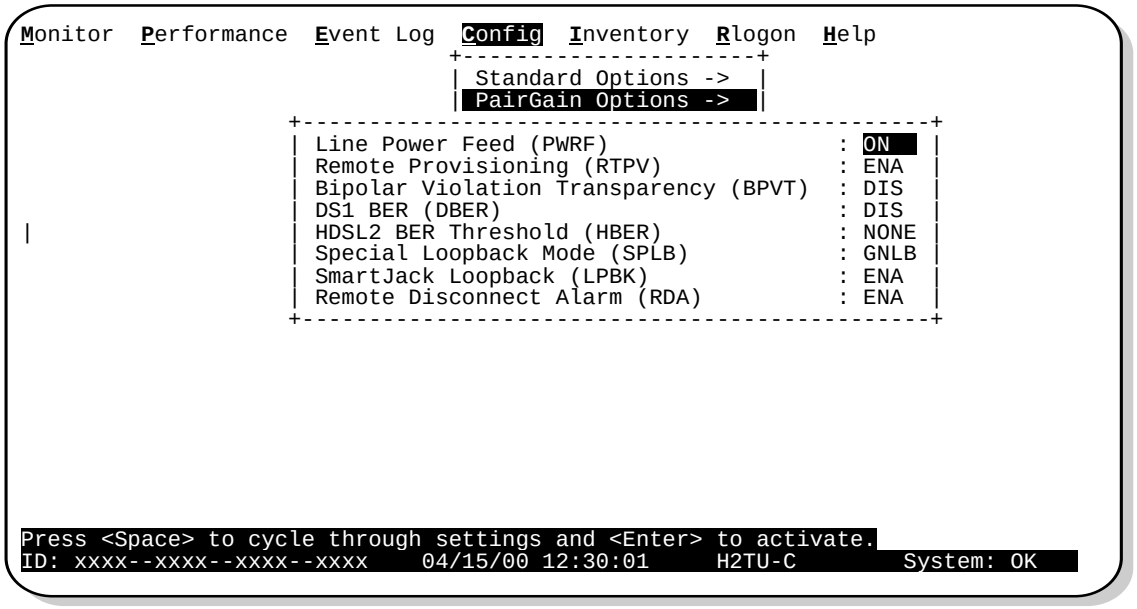


Figure 8. *Configuration Menu - ADC Options (Defaults Shown)*

Table 5 describes the Standard Config screen options and lists their front-panel display codes. Table 6 on page 18 describes the ADC Config screen options. Selections in bold typeface are the factory default settings.

Table 5. *HiGain Line Unit List 1 Standard Config Screen Options*

Standard Config Screen Options	Screen Display Code	Selection	Description
Loopback Timeout	LBTO	NONE	Disables automatic time-out cancellation of all loopbacks.
		20	Sets automatic cancellation of all loopbacks to 20 minutes after initiation.
		60	Sets automatic cancellation of all loopbacks to 60 minutes after initiation.
		120	Sets automatic cancellation of all loopbacks to 120 minutes after initiation.
Loop Attenuation Threshold	LATT	0 through 40 dB	Determines the maximum loop attenuation before an alarm is declared. The loop attenuation threshold can only be set through the HiGain HDSL2 maintenance screens.
		35 dB	Default value. Zero disables the alarm.
Margin Threshold	MARG	0 to 15 dB	Determines the minimum allowable margin below which a system alarm can occur. Zero disables the alarm.The Margin Alarm Threshold can only be set through the HiGain HDSL2 maintenance screens.
		4dB	Default value.
DS1 Frame Formatting	FRMG	**AUTO**	Configures the HiGain system to operate in an auto-framing (AUTO) mode. It detects and locks to both SF or ESF DS1 frame patterns. Line and path performance parameters are maintained and displayed. Unframed payloads will cause the ES-P and SES-P counters to increment.
		SF	Configures the HiGain system to search for the SF framing pattern at its DS1 input.
		ESF	Configures the HiGain system to search for the ESF framing pattern at its DS1 input.
		UNFR	Configures the same as AUTO except unframed payloads do not cause the ES-P and SES-P counters to increment.
DS1 Line Coding (see "DS1 Line Coding (DS1) Option" on page 19)	DS1	**AUTO**	The H2TU-C-388 and H2TU-R monitor the incoming DS1 bit streams for the B8ZS code. If the H2TU-R detects this code, the H2TU-C enters B8ZS output mode. The H2TU-C reverts back to AMI output mode if no B8ZS codes are received at the H2TU-R input for 5 seconds. Similarly, when the H2TU-C detects the B8ZS code, the H2TU-R enters B8ZS mode and returns to AMI mode if no B8ZS code is received at the H2TU-C input for 5 seconds.
		B8ZS	Places both the H2TU-C-388 and H2TU-R into B8ZS mode.
		AMI	Places both the H2TU-C-388 and H2TU-R into AMI mode.
H2TU-C Equalization See "H2TU-C Equalization (EQL) Option." on page 19.	EQL	**0**	Sets the Equalizer to DSX-1 for 0 to 132 feet.
		133	Sets the Equalizer to DSX-1 for 133 to 265 feet.
		266	Sets the Equalizer to DSX-1 for 266 to 398 feet.
		399	Sets the Equalizer to DSX-1 for 399 to 532 feet.
		533	Sets the Equalizer to DSX-1 for 533 to 655 feet.
H2TU-R Line Buildout	RLBO	**0 dB**	Sets the DS1 receive level output toward the Customer Interface (CI). Can only be set through the HiGain HDSL2 maintenance screens.
		-7.5 dB	Sets the DS1 RLBO level toward the CI to -7.5 dB.
		-15 dB	Sets the DS1 RLBO level toward the CI to -15.0 dB.
Alarm Pattern	ALMP	**AIS**	Enables the HiGain system to output an AIS payload at its DS1 ports for LOSW and DS1 LOS. See Figure 25 on page 38 for LOS/AIS response priorities.
		LOS	Enables the HiGain system to output an LOS condition at its DS1 ports for LOSW and DS1 LOS.

Continued

Table 5. *HiGain Line Unit List 1 Standard Config Screen Options (Continued)*

Standard Config Screen Options	Screen Display Code	Selection	Description
H2TU-R TLOS Loopback	TLOS	ENA	Enables a logic loopback at the H2TU-R when an LOS occurs at its DS1 input. See Figure 25 on page 38 for LOS/AIS response priorities.
		DIS	Disables TLOS logic loopback.
Network Loopback Pattern	NLBP	**AIS**	Enables the H2TU-R to transmit AIS towards the CI for any network loopback. See Figure 25 on page 38 for LOS/AIS response priorities.
		LOS	Enables the H2TU-R to transmit LOS towards the CI for any network loopback.

Table 6. *HiGain Line Unit List 1 ADC Config Screen Options*

ADC Config Screen Options	Screen Display Code	Selection	Description
Line Power Feed	PWRF	OFF	Disables powering to the HDSL2 pair.
		ON	Keeps the HDSL2 line voltage at nominal -185 Vdc.
Remote Provisioning	RTPV	**ENA**	Enables remote provisioning.
		DIS	Disables remote provisioning.
Bipolar Violation Transparency See "Bipolar Violation Transparency (BPVT) Option" on page 19.	BPVT	ENA	Enables BPVs and HDSL2 CRC errors at the DS1 input to be converted into DS1 BPVs at the DS1 output at the distant end. This makes HiGain transparent to BPVs.
		DIS	Disables BPV Transparency.
DS1 BER Threshold	DBER	ENA	Enables the fixed 24-hour DS1 BER threshold.
		DIS	Prevents the generation of a system alarm due to DS1 BER.
HDSL2 BER Threshold See "HDSL2 BER Threshold (HBER) Option" on page 19.	HBER	1E-6	The Status LED flashes red when the Block Error Rate (BER) exceeds 10^{-6}.
		1E-7	The Status LED flashes red when BER exceeds 10^{-7}.
		NONE	Prevents generation of a system alarm due to BER.
Special Loopback Mode	SPLB	**GNLB**	Configures the HiGain system to respond to the generic inband loopback codes.
		A1LB and A2LB	Configures the HiGain system to respond to the inband loopback codes of the Teltrend addressable repeater.
		A3LB	Configures the HiGain system to respond to the inband loopback codes of the Wescom addressable repeater.
		A4LB	Configures the HiGain system to respond to the inband loopback codes of the Wescom Mod 1 addressable repeater.
		A5LB	Configures the HiGain system to respond to the inband loopback codes of the Teltrend Mod 1 addressable repeater.
SmartJack Loopback	LPBK	**ENA**	Enables the HiGain system to recognize all inband SmartJack (SMJK) loopback commands.
		DIS	Configures the HiGain system to ignore all inband SmartJack loopback commands.

Continued

Table 6. *HiGain Line Unit List 1 ADC Config Screen Options (Continued)*

ADC Config Screen Options	Screen Display Code	Selection	Description
Remote Disconnect Alarm	RDA	**ENA**	Enables a remote DS1 LOS condition at the input to the H2TU-R to generate an LOS alarm. AIS or LOS (depending on ALMP) is sent towards the network.
		DIS	Prevents a remote DS1 LOS condition at the input to the H2TU-R from causing an LOS alarm. The front-panel Status LED still flashes red and the ALRM RLOS message displays. The LOS is sent towards the network from the H2TU-C instead of AIS.

HDSL2 BER Threshold (HBER) Option. The HBER option permits monitoring of loop integrity and reporting of alarms when excessive errors are detected. The PM primitive used for this purpose is the CRC checksum performed on the HDSL2 frame for both directions of transmission. It is, therefore, called a block error rate rather than the bit error rate associated with the DS1 interface. The CRC errors and counts display on the Monitor screen for both the H2TU-C and H2TU-R. The HBER option allows an alarm to be generated if the total number of CRCs at either the H2TU-C or H2TU-R exceeds the selected BER threshold during the last 1-minute interval.

- HBER option = 1E-6. Alarm is generated if CRC > 92
- HBER option = 1E-7. Alarm is generated if CRC > 9

Once initiated, the HBER count clears when the CRC count drops below the selected threshold. Selecting NONE inhibits this alarm.

DS1 Line Coding (DS1) Option. The DS1 line code option should always be set to conform to the type of DS1 service (AMI or B8ZS) being provided by the HiGain system. The Auto mode, which can adapt to either AMI or B8ZS, should only be used in applications that require it (such as when HiGain acts as a standby circuit to DS1 circuits whose line codes are not known or may be both AMI and B8ZS). This is because the Auto mode induces one BPV in the DS1 bit stream whenever it switches from AMI to B8ZS. The Auto mode allows both the H2TU-C and the H2TU-R to set its DS1 output code to that which is being received at the distant end DS1 input. This forces the input and the output codes in each direction of transmission to be identical.

H2TU-C Equalization (EQL) Option. Equalization is the configuration of system transmission characteristics within specified limits. An adaptive equalizer inserts a frequency-shaped loss that corresponds to an equivalent addition of an appropriate cable length. By simulating the additional cable loss necessary for correct operation, the equalizer compensates for a range of variation in transmission path characteristics.

Bipolar Violation Transparency (BPVT) Option. The HiGain Line Unit improves compatibility with Digital Loop Carrier (DLC) feeder applications because of its ability to transmit DS1 BPV occurrences between its DS1 interfaces. This feature is required to support protection switching in DLC applications. Each DLC terminal must be able to monitor the integrity of its Receive DS1 payload and then switch to the protect line when the integrity of the path drops below specific user selected limits. An essential requirement of this feature is the need for each DLC terminal to detect BPVs in its DS1 input. Standard HDSL systems correct DS1 BPVs at the input and therefore prevent them from being detected by the DLC terminals to which they are connected. The HiGain Line Unit and its associated remote units remove this limitation and become BPV transparent by detecting and counting input BPVs at each end and then by replicating them at the DS1 output port of the distant end.

The BPV count is converted into BPVs at the distant end during the following second at a rate of 1 BPV every 128 DS1 bits up to a maximum of 12000 (BER=7.7 x 10^{-3}). This maximum rate is more than adequate since it exceeds the maximum 10^{-3} BER required by most DLC systems.

DS1 BER (DBER) Option. The DS1 BER alarm occurs when any of the DS1 or DSX-1 performance monitoring parameters listed in Table 7 exceed the counts shown for the 24-hour period between 12:00:00 AM through 11:59:59 PM. These thresholds correspond to a 10^{-6} BER. All PM counters clear to zero at 12:00:00 AM or when Master Clear is selected.

Table 7. *DS1/DSX-1 24-hour PM Threshold*

Parameter	Threshold Count
CV-L (BPV)	133,400
ES-L, ES-P, PRM-NE, PRM-FE	648
SES-L, SES-P	100
UAS-P, UAS-L	10

Resetting the H2TU-C

Resetting the H2TU-C-388 to its original factory settings may cause interruption of service.

To reset the HiGain Line Unit to its original factory defaults:

1 Type C to select the Config menu.

2 Use the ↑ and ↓ arrow keys to select **Set Factory Defaults**, then press ENTER.

3 Type Y if you are certain you want to reset the H2TU-C, or press N to cancel this action.

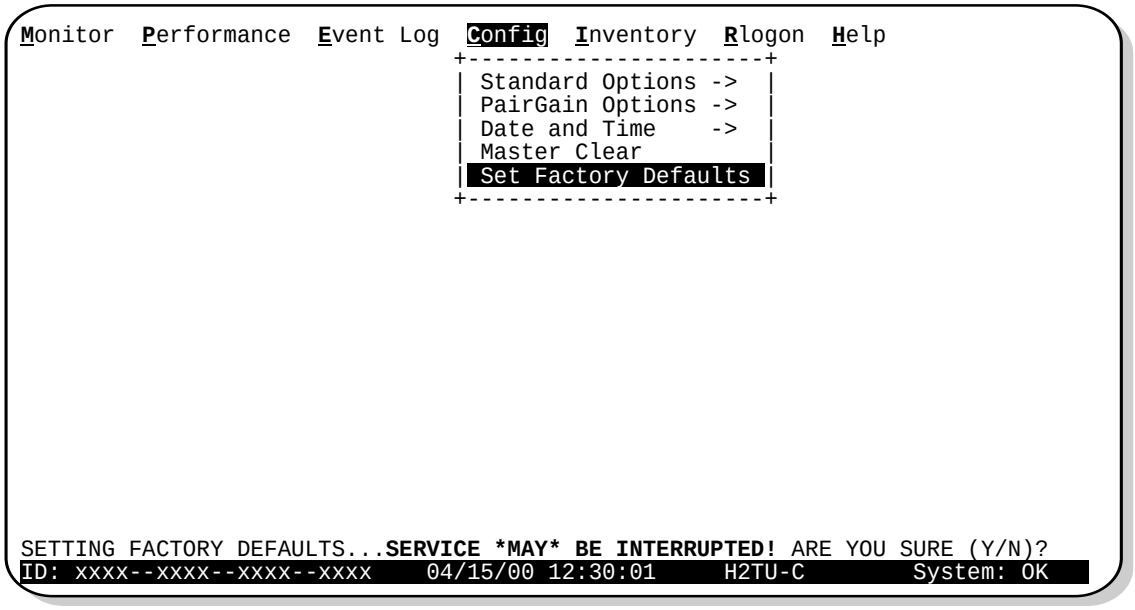


Figure 9. *Configuration Menu - Reset to Factory Defaults*

Clearing the History, Alarm, and Event Log Screens

Clear the History, Alarm and Event Log screens after the system has been installed and is functioning properly. This removes miscellaneous data acquired during the startup session and ensures collection of accurate and meaningful data thereafter.

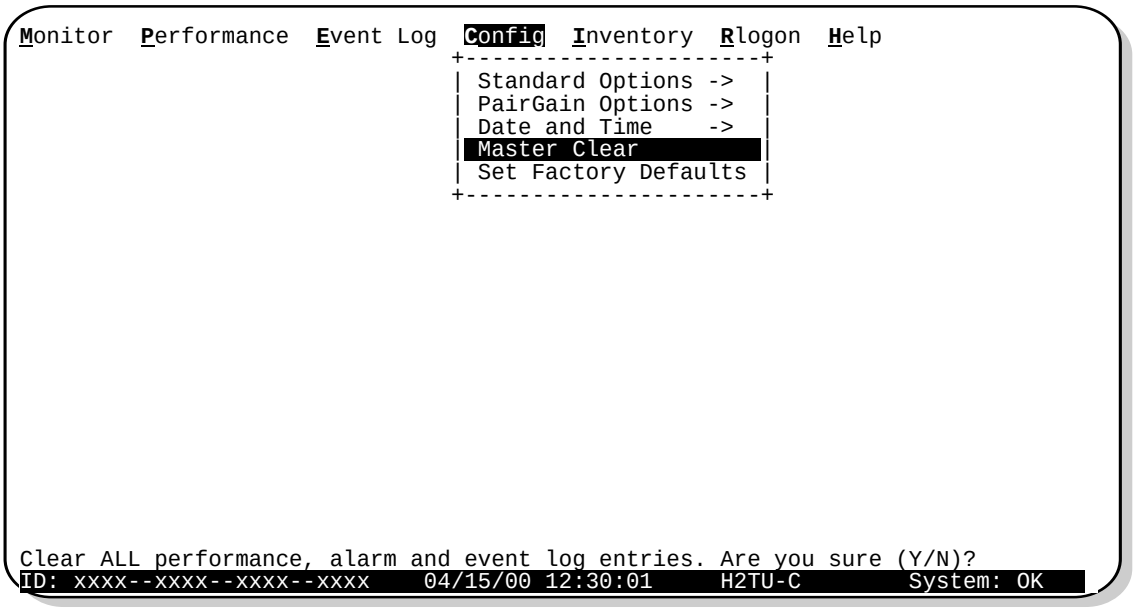


Figure 10. *Master Clear*

To clear the Event Log, type E to select the Event Log screen, then type L to clear the screen.

To clear an individual history or alarm screen, do the following:

1. Type P to select the Performance screen.
2. Press the SPACEBAR to select either interface (**H2TU-C DS1, H2TU-R DS1, H2TU-C HDSL2** or **H2TU-R HDSL2**), then press ENTER.
3. Press the SPACEBAR to select the type of statistics (**Current**, **Alarm History**, **25 Hour History, 48 Hour History**, or **31 Day History**) and press ENTER after your selection.
   - Selecting **31 Day History** allows you to clear the Current, 25-hour, 48-hour, and 31-day performance history screens for the selected interface.
   - Selecting **Alarm History** allows you to clear the alarm history screen for the selected interface. For information about the DS1 and HDSL2 Alarm screens, see Table 11 on page 32.
4. Type L to clear the screen.

To clear ALL history, alarm, and event log screens by this method:

1. Type C to select the Config screen.
2. Select **Master Clear**.
3. Type Y to clear all screens.

MONITORING SYSTEM ACTIVITY AND PERFORMANCE

The H2TU-C-388 List 1 provides two sets of maintenance screens for monitoring system activity and assessing performance.

- The Monitor screens provide a graphical representation of circuit activity and allow initiation of loopbacks.
- The Performance screens provide current, 25-hour, 48-hour, and 31-day performance histories and a continuous alarm history.
- The Event Log provides a description of the 100 most recent events.

USING THE MONITOR SCREEN TO VIEW SYSTEM ACTIVITY

1 Type **M** to view the system diagram.

Figure 11 shows an armed circuit with an active loopback and alarms. Terms used on the system diagram are defined in the onscreen Help menu glossary. Abnormal situations are highlighted on the diagram. See Table 8 on page 23 for screen field descriptions.

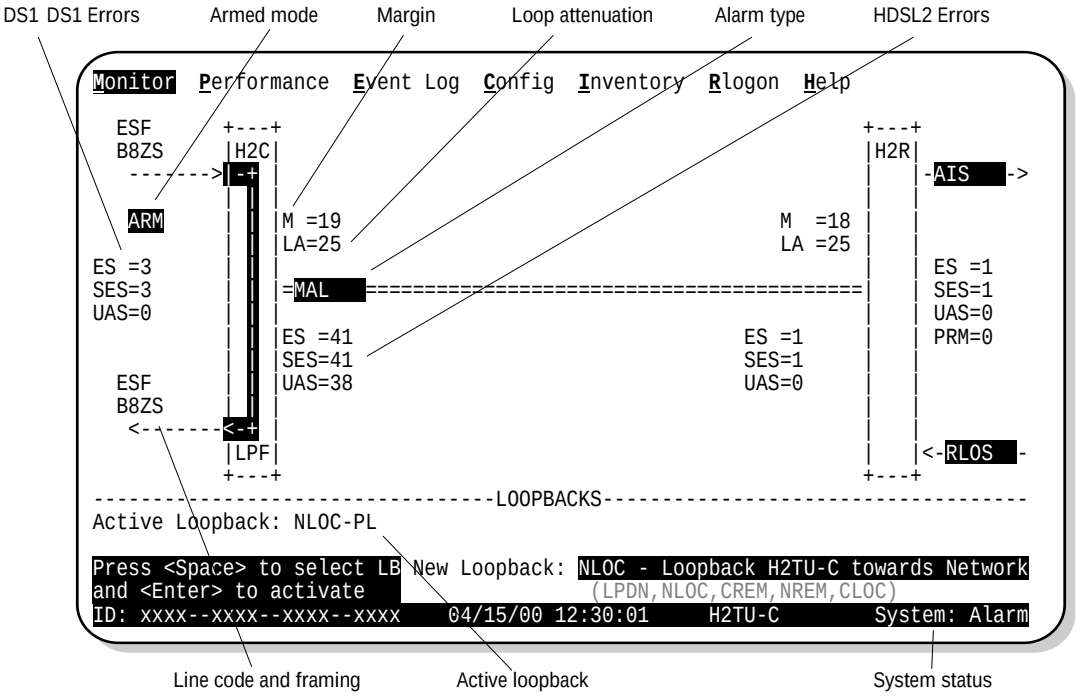


Figure 11. *Monitor Screen - Active Loopback with Alarms*

2 To initiate a loopback, press the **SPACEBAR** to cycle through the loopback choices. Press **ENTER** to make your choice,

When prompted with the message: `Are you sure (Y/N)?`, press **Y** to initiate the loopback or **N** to cancel. For more information about loopbacks and troubleshooting, see "Testing" on page 36.

3 To initiate a loopdown of all active loopbacks, press the **SPACEBAR** to select **LPDN**, then press **ENTER** or **N**. When prompted with the message: `Are you sure (Y/N)?`, press **Y** to initiate the loopdown or **N** to cancel.

Table 8. *Monitor Screen Descriptions*

Field	Description
Active Loopback	An active loopback is indicated on the lower third of the Monitor screen. Available loopbacks are indicated by gray text. See Table 15 on page 40 for a summary of the HiGain loopback codes.
Alarm type	Indicates type of alarm.
Armed mode	Indicates system is in an armed state for an intelligent repeater loopback command.
Code type	Type of DS1 line coding received or sent (B8ZS or AMI).
DS1 ES Count	Errored Seconds—The sum of the Errored Seconds-Line (ES-L) and Errored Seconds-Path (ES-P) counts detected on the DS1 input over a 24-hour period. Errors included are: DS1 Frame errors, BPV, and ESF CRC errors.
DS1 SES Count	Severely Errored Seconds—The sum of the DS1 Severely Errored Seconds-Line (SES-L) and Severely Errored Seconds-Path (SES-P) counts over the last 24 hours.
DS1 UAS Count	Unavailable Errored Seconds—The number of seconds during which the DS1 input signal was absent over a 24-hour period.
Frame type	Type of DS1 framing detected at the input stream (SF, ESF, or UNFR).
HDSL2 ES Count	Errored Seconds—The number of 1-second intervals that contained at least one CRC or LOSW error. This value is a running total of the last 24 Hours.
HDSL2 SES Count	Severely Errored Seconds—The number of 1-second intervals that contain at least 50 CRC errors or one or more LOSW defects. (An LOSW defect occurs when at least three consecutive HDSL frames contain one or more frame bit errors.) This value is a running total of the last 24 hours.
HDSL2 UAS Count	Unavailable Errored Seconds—The number of seconds the HDSL2 loop is unavailable. This occurs after 10 contiguous HDSL SES and is retired after 10 contiguous non-SES seconds. This value is a running total of the last 24 hours.
ID	Circuit identification (ID) number.
LA	Loop Attenuation—Indicates the attenuation of the Overlapped PAM Transmission with Interlocking Spectra (OPTIS) pulse from the distant end. The value is related to the loop attenuation at 196 kHz and should be kept under 35 dB.
LPF	Line Power Feed—Indicates the HDSL2 line power is on.
M	Margin—The signal-to-noise ratio at all HDSL2 ports, relative to a 10^{-7} Bit Error Rate.
MAL	Margin Alarm—Indicates the margin on HDSL2 loop has dropped below the threshold (0 to 15dB) as set by the operator.
PL (or HG)	PL displays when the loopback was initiated by a command embedded in the DS1 data path payload (PL). HG displays when the loopback was initiated from a HiGain Generic (HG) front panel or by a HiGain maintenance terminal loopback command.
PRM	The sum of the Performance Report Messaging-Near End (PRM-NE) and Performance Report Messaging-Far End (PRM-FE) counts.
System Status	The presence or absence of an alarm condition is indicated on the lower right corner of all screens. **System: OK** indicates that there are no alarms present; **System: Alarm** indicates the presence of an alarm. Refer to "Using the Performance Screens to View Alarm Data" on page 30 for detailed alarm information.

USING THE PERFORMANCE SCREENS TO VIEW PERFORMANCE DATA

The Performance screens display:

- CRC statistics for the HDSL2 or DS1 interface in 31-day, 48-hour, 25-hour, and current history reports
- Alarm statistics for the HDSL2 (Figure 23 on page 33) or DS1 interfaces (Figure 22 on page 31) on a continuous basis

To access the Performance history screens:

1 Type **P** to select the Performance screen.

2 Press the **SPACEBAR** to select either interface (**H2TU-C DS1, H2TU-R DS1, H2TU-C HDSL2** or **H2TU-R HDSL2**), then press **ENTER**.

3 Press the **SPACEBAR** to select the type of statistics (**Current**, **Alarm History**, **25 Hour History, 48 Hour History**, or **31 Day History**), then press **ENTER**.

Performance History at the DS1 Interface

The Performance History for the DS1 Interface provides 31-day, 48-hour, 25-hour, and current statistics screens for the H2TU-C and the H2TU-R (as viewed from the H2TU-C). Figure 12 below and Figure 13 on page 25 are examples of DS1 performance history screens at the remote unit. Figure 14 on page 25 is an example of DS1 performance history screens at the line unit. Refer to Table 9 on page 27 for descriptions of the kinds of errors reported on DS1 interface screens.

```
Monitor  Performance  Event Log  Config  Inventory  Rlogon  Help

                H2TU-R DS-1 31 Day History (Page 1 of 3)
-------------------------------------------------------------------------------
 Date     CV-L   ES-L  SES-L   UAS-L   CV-P   ES-P  SES-P  UAS-P PRM-NE PRM-FE
 04/01       -      -      -       -      -      -      -      -      -      -
 04/02       -      -      -       -      -      -      -      -      -      -
 04/03       -      -      -       -      -      -      -      -      -      -
 04/04       -      -      -       -      -      -      -      -      -      -
 04/05       -      -      -       -      -      -      -      -      -      -
 04/06       -      -      -       -      -      -      -      -      -      -
 04/07       -      -      -       -      -      -      -      -      -      -
 04/08       -      -      -       -      -      -      -      -      -      -
 04/09       -      -      -       -      -      -      -      -      -      -
 04/10       -      -      -       -      -      -      -      -      -      -
 04/11       -      -      -       -      -      -      -      -      -      -
 04/12      12     14     10      10     10     10      0      0      0      0
 04/13       2      0      0       0      0      0      0      0      0      0

              Press: (N)ext Page, (P)revious Page, C(l)ear History
-------------------------------------------------------------------------------
Press <Space> to cycle through   Interface  : H2TU-R DS-1
choices and <Enter> to view      Statistics : 31 Day History
ID: xxxx--xxxx--xxxx--xxxx    04/15/00 12:30:01     H2TU-C        System: OK
```

Figure 12. *H2TU-R DS1 31-Day Performance History*

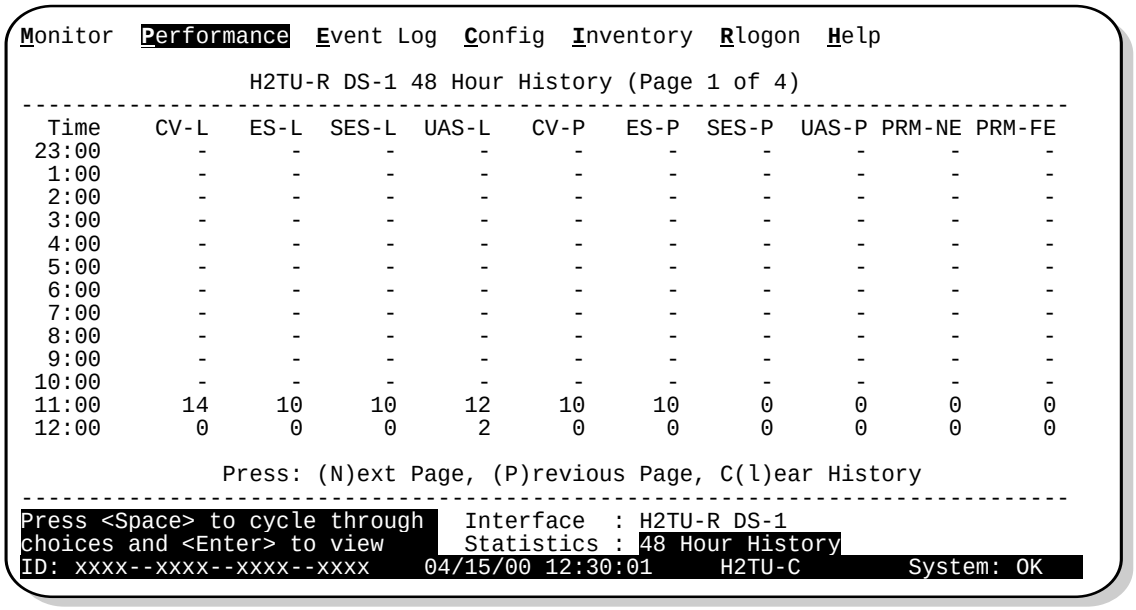


Figure 13. *H2TU-R DS1 48-Hour Performance History*

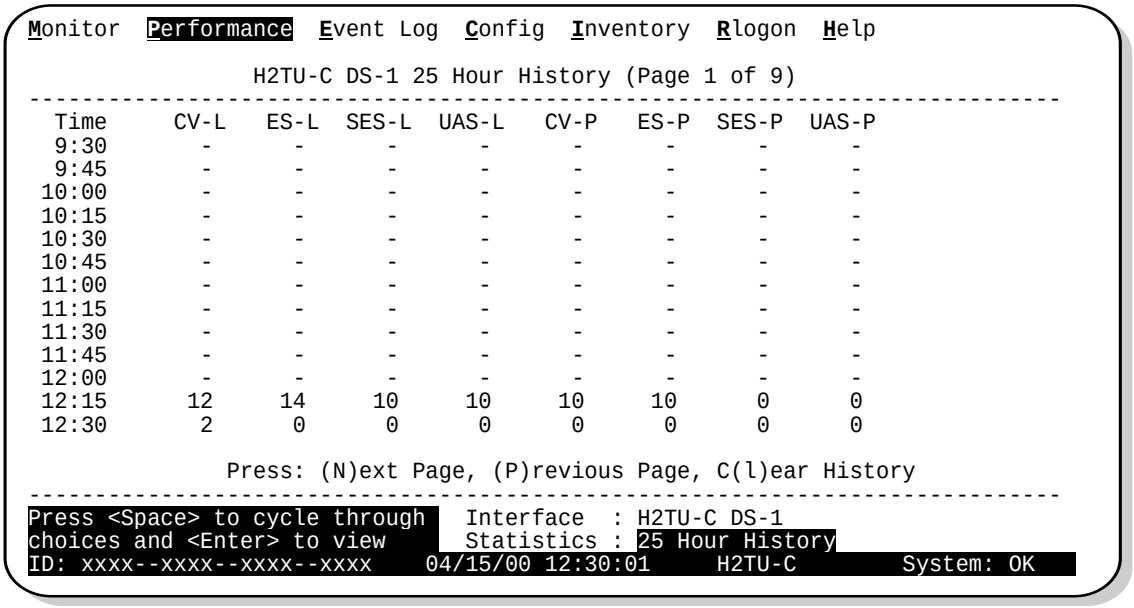


Figure 14. *H2TU-C DS1 25-Hour Performance History*

Examples of current statistics screens are shown below. Figure 15 and Figure 16 show statistics for the DS1 interface at the remote unit and line unit, respectively. These screens report 1-day, 1-hour, and 15-minute statistics.

```
Monitor  Performance  Event Log  Config  Inventory  Rlogon  Help

                      H2TU-R DS-1  Current Statistics
-------------------------------------------------------------------------------
          1 Day   1 Hour   15 Min
Start     00:00    12:00    12:30

CV-L          0        0        0
ES-L          0        0        0
SES-L         0        0        0
UAS-L         0        0        0
CV-P          0        0        0
ES-P          0        0        0
SES-P         0        0        0
UAS-P         0        0        0
PRM-NE        0        0        0
PRM-FE        0        0        0
B8ZSS         0        0        0
MSEC       3482     1801        1
                    Press: C(l)ear Current Statistics
-------------------------------------------------------------------------------
Press <Space> to cycle through   Interface  : H2TU-R DS-1
choices and <Enter> to view      Statistics : Current
ID: xxxx--xxxx--xxxx--xxxx    04/15/00 12:30:01     H2TU-C         System: OK
```

Figure 15. *H2TU-R DS1 Current Statistics*

```
Monitor  Performance  Event Log  Config  Inventory  Rlogon  Help

                       H2TU-C DS-1 Current Statistics
-------------------------------------------------------------------------------
          1 Day   1 Hour   15 Min
Start     00:00    12:00    12:30

CV-L          0        0        0
ES-L          0        0        0
SES-L         0        0        0
UAS-L         0        0        0
CV-P          0        0        0
ES-P          0        0        0
SES-P         0        0        0
UAS-P         0        0        0


B8ZSS         0        0        0
MSEC       3482     1801        1
                    Press: C(l)ear Current Statistics
-------------------------------------------------------------------------------
Press <Space> to cycle through   Interface  : H2TU-C DS-1
choices and <Enter> to view      Statistics : Current
ID: xxxx--xxxx--xxxx--xxxx    04/15/00 12:30:01     H2TU-C         System: OK
```

Figure 16. *H2TU-C DS1 Current Statistics*

Table 9. *Acronyms Used on the DS1 Performance History Screens*

Error Acronym	Description	Error Acronym	Description
CV-L	Code Violation - Line Total BPV count.	SES-P	Severely Errored Seconds - Path Seconds with SES or CRC(ESF) ≥320 or FE [a](SF) ≥8 (F_T + F_S).
ES-L [b]	Errored Seconds - Line Seconds with BPV ≥1.	UAS-P	Unavailable Seconds - Path A second of unavailability based on SES-P or AIS ≥1.
SES-L	Severely Errored Seconds - Line Seconds with BPV plus EXZ ≥1544.	PRM-NE [c]	Performance Report Messaging - Near End The PRM from CPE indicates errors, and the signal received from the network at the remote is error-free.
UAS-L	Unavailable Seconds - Line Seconds with LOS ≥1.	PRM-FE [c]	Performance Report Messaging - Far End The PRM from the network indicates errors, and the signal received from the CPE is error-free.
CV-P	Code Violation - Path Total count of SF frame bit (FB) errors or ESF, CRC errors.	B8ZSS [d]	B8ZS Monitored Seconds Seconds with B8ZS detection when AMI option is active.
ES-P [e]	Errored Seconds - Path Seconds with SEF [f], CRC (ESF) or FE [b](SF) ≥1.	MSEC [d]	Monitored Seconds of the current (15 minute/1 hour/1 day) screen.

(a) FE is a frame bit error.
(b) Line refers to the AMI, DS1 line code used to transport the payload.
(c) Only appears on H2TU-R Performance History screens.
(d) Appears on the DS1 Current Statistics screens.
(e) Path refers to the total framed payload being transported between two points.
(f) Severely Errored Frame—Two or more frame bit errors occurring in a 0.75 ms interval for SF or a 3 ms interval for ESF.

Performance History at the HDSL2 Interface

The HDSL2 interface has 31-day, 48-hour, 25-hour, and current statistic screens for the H2TU-C. Figure 17 and Figure 18 below are examples of 31-day and 48-hour performance history screens. Figure 19 and Figure 20 on page 29 are examples of 25-hour and current statistics performance history screens, respectively. Refer to Table 10 on page 30 for descriptions of the kinds of errors reported on all HDSL2 performance screens.

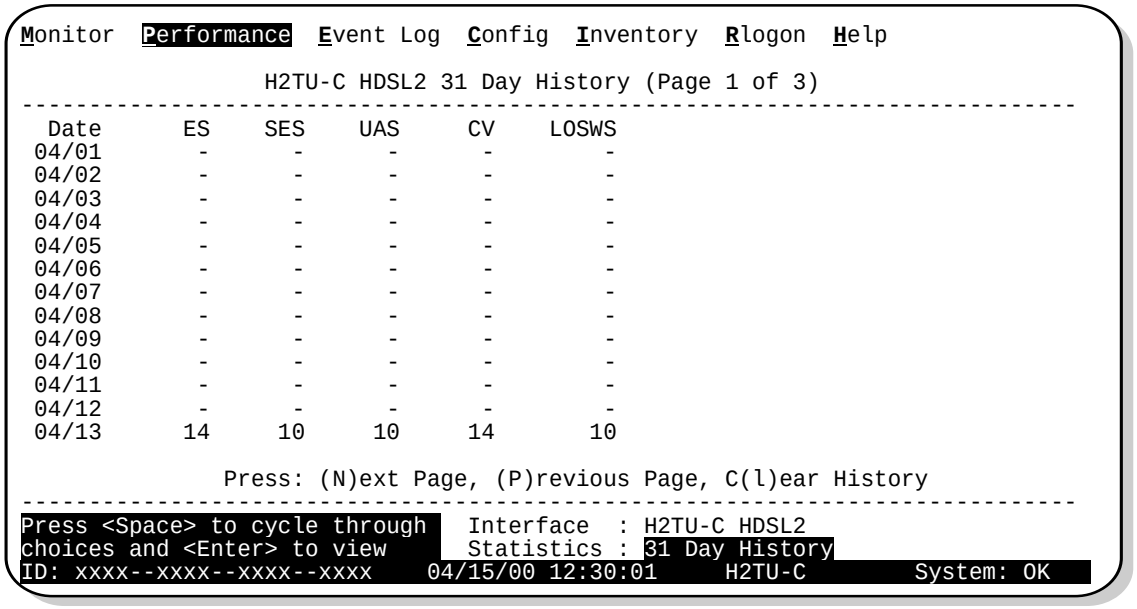


Figure 17. *H2TU-C HDSL2 31-Day Performance History*

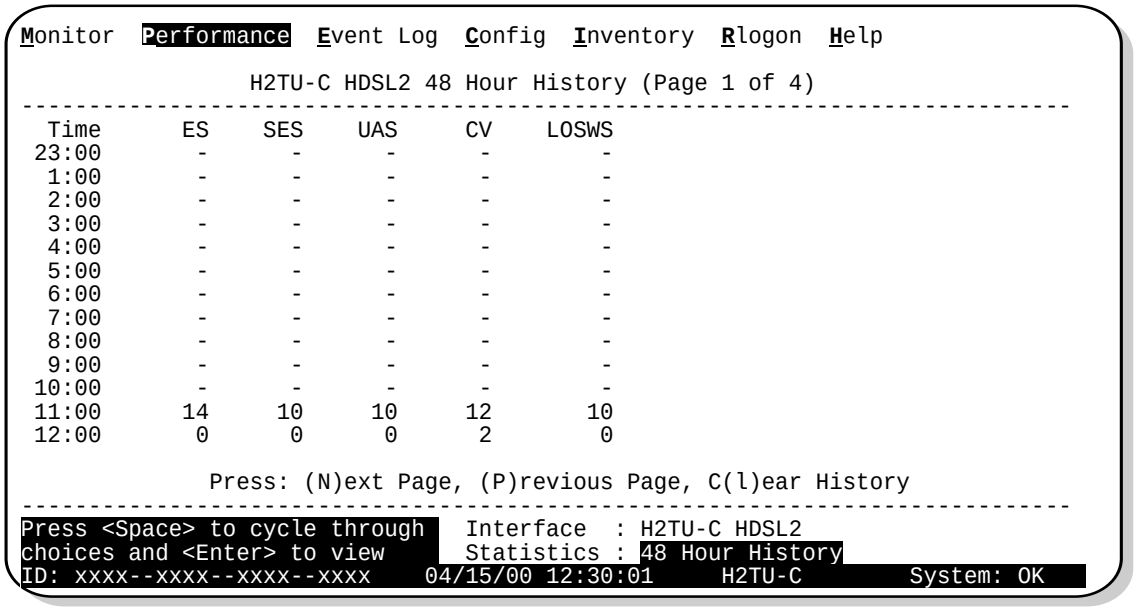


Figure 18. *H2TU-C HDSL2 48-Hour Performance History*

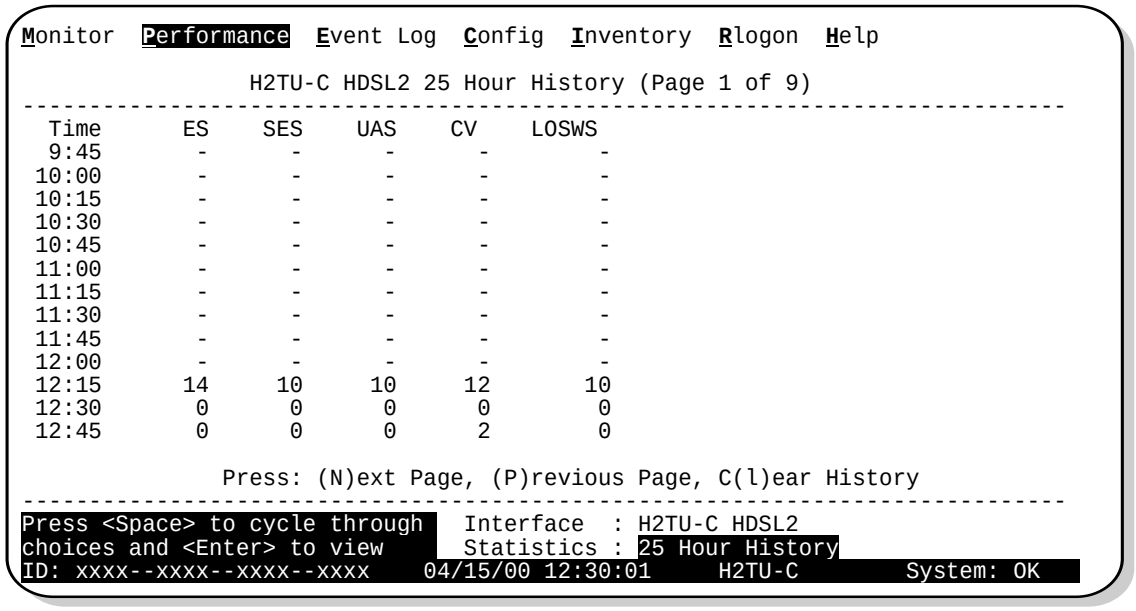


Figure 19. *H2TU-C HDSL2 25-Hour Performance History*

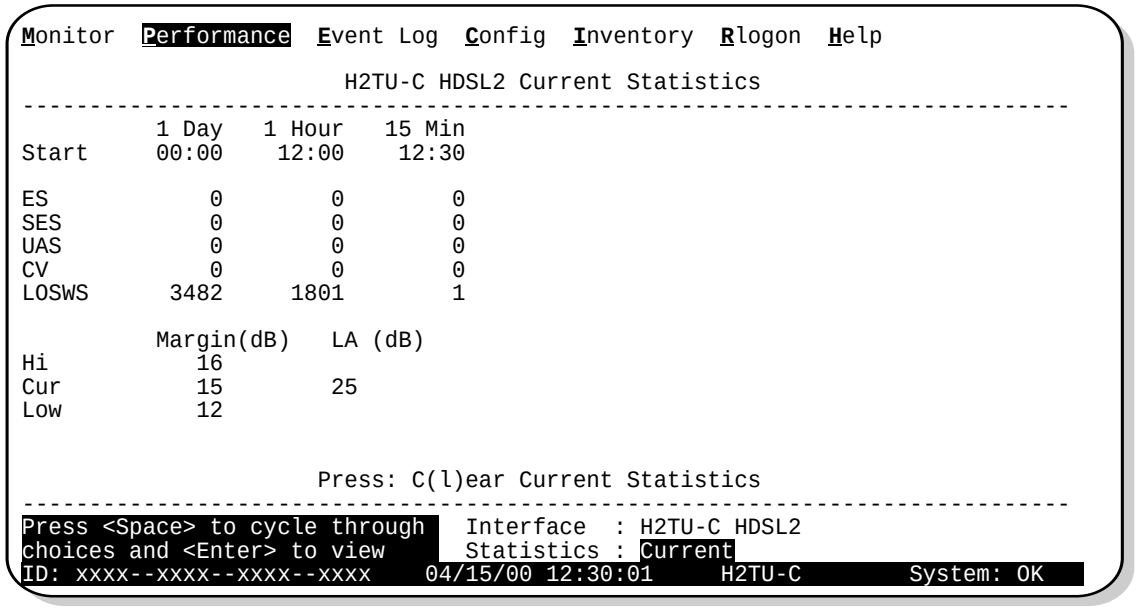


Figure 20. *H2TU-C HDSL2 Current Statistics*

Table 10. *Acronyms Used on the HDSL2 Performance History Screens*

Error Acronym	Description
ES	Errored Seconds Seconds with HDSL2 CRC ≥1 or LOSW ≥1
SES	Severely Errored Seconds Seconds with HDSL2 CRC ≥50 or LOSW ≥1
UAS	Unavailable Seconds Based on 10 contiguous SES occurrences
CV	Code Violation Total count of HDSL2 CRC errors
LOSWS	Loss of Sync Word Second Seconds with LOSW ≥1

USING THE PERFORMANCE SCREENS TO VIEW ALARM DATA

To access the alarm history screens:

1 Type **P** to select the Performance screen.

2 Press the **SPACEBAR** to select an interface (**H2TU-C DS1, H2TU-R DS1, H2TU-C HDSL2** or **H2TU-R HDSL2**), then press **ENTER**.

3 Press the **SPACEBAR** until **Alarm History** is selected, then press **ENTER**.

- Press **N** or **P** to page through the alarm history screens.
- Press **L** to clear the selected alarm history screen.

Alarm History at the DS1 Interface

The Alarm History screen reports DS1 statistics for the H2TU-C (Figure 21) and the H2TU-R (Figure 22 on page 31) on a continuous basis. The types of alarms reported are described in Table 11 on page 32. Current alarms are shown in reverse video.

```
Monitor  Performance  Event Log  Config  Inventory  Rlogon  Help

                          H2TU-C DS-1 Alarm History
-------------------------------------------------------------------------------
 Alarm        First                Last                 Status      Count

 LLOS         04/03/00 00:00       04/03/00 00:45       ALARM          12
 LAIS                                                   OK              0
 DBER         04/03/00 00:37       04/03/00 00:45       OK              7
 LOF                                                    OK              0









                          Press: C(l)ear Alarm History
-------------------------------------------------------------------------------
Press <Space> to cycle through   Interface  : H2TU-C DS-1
choices and <Enter> to view      Statistics : Alarm History
ID: xxxx--xxxx--xxxx--xxxx    04/15/00 12:30:01     H2TU-C        System: Alarm
```

Figure 21. *H2TU-C DS1 Alarm History Screen*

```
Monitor  Performance  Event Log  Config  Inventory  Rlogon  Help

                          H2TU-R DS-1 Alarm History
-------------------------------------------------------------------------------
 Alarm        First                Last                 Status      Count

 RLOS         04/03/00 00:00       04/03/00 00:45       ALARM          12
 RAIS                                                   OK              0
 RAI                                                    OK              0
 LRAI                                                   OK              0
 PRM-NE                                                 DISABLED        0
 PRM-FE                                                 DISABLED        0
 DBER         04/03/00 00:37       04/03/00 00:45       OK              7
 LOF                                                    OK              0









                          Press: C(l)ear Alarm History
-------------------------------------------------------------------------------
Press <Space> to cycle through   Interface  : H2TU-R DS-1
choices and <Enter> to view      Statistics : Alarm History
ID: xxxx--xxxx--xxxx--xxxx    04/15/00 12:30:01     H2TU-C        System: Alarm
```

Figure 22. *H2TU-R DS1 Alarm History Screen*

Table 11. *DS1 Alarm Descriptions*

Screen Alarm	Front-Panel Alarm	Description
H2TU-C DS1 ALARMS (Figure 21 on page 31)		
LLOS [(a)]	LLOS	Local Loss of Signal—Loss of the H2TU-C DSX-1 input signal.
LAIS [(a)]	LAIS	Local Alarm Indication Signal—Indicates an AIS (all ones) pattern is transmitted from the local DS1 output port. The ALMP option determines whether AIS (default) or LOS is sent towards the CPE.
DBER	DBER	Bit Error Rate—The DS1 BER has exceeded the built-in 24-hour threshold limits of approximately 10^{-6}.
LOF	LOF	Loss of Frame—Indicates the incoming DS1 frame pattern is other than the one selected, ESF or SF, by the FRMG option. Only occurs if the FRMG option is set to SF or ESF.
H2TU-R DS1 ALARMS (Figure 22 on page 31)		
RLOS [(b)]	RLOS	Remote Loss of Signal—Loss of the H2TU-R DS1 input signal.
RAIS	RAIS	Remote Alarm Indication Signal—Indicates an AIS (all ones) pattern is being transmitted from the remote DS1 output port. By default (see Figure 25 on page 38) AIS-CI [(b)]is sent towards the network.
RAI	RRAI	Remote RAI—Indicates an RAI alarm (yellow) from the CPE with errors from the line unit or network.
LRAI	LRAI	Line RAI—Indicates an RAI alarm (yellow) from the CPE with an error-free signal from the line unit or network.
PRM-NE	PRMN	Performance Report Messaging - Near End—The count of the PRM-NE register at the H2TU-R exceeds the 10^{-6} BER threshold at 648 events since 12:00:00 AM.
PRM-FE	PRMF	Performance Report Messaging - Far End—The count of the PRM-FE register at the H2TU-R exceeds the 10^{-6} BER threshold at 648 events since 12:00:00 AM.
DBER	DBER	Bit Error Rate—The DS1 BER has exceeded the built-in 24-hour threshold limits of approximately 10^{-6}.
LOF	LOF	Loss of Frame—Indicates the incoming DS1 frame pattern is other than the one selected, ESF or SF, by the FRMG option. Only occurs if the FRMG option is set to SF or ESF.

(a) Issues a minor alarm (sent to the management unit or the backplane), if enabled.
(b) AIS-CI is a modified AIS alarm pattern. Equipment not suited to detect AIS-CI still detects this signal as an AIS. AIS-CI is sent toward the network indicating that an LOS (RLOS) or AIS (RAIS) has been received from the CPE.

Alarm History at the HDSL2 Interface

Figure 23 shows the H2TU-C HDSL2 alarm history, and Table 12 describes the alarms.

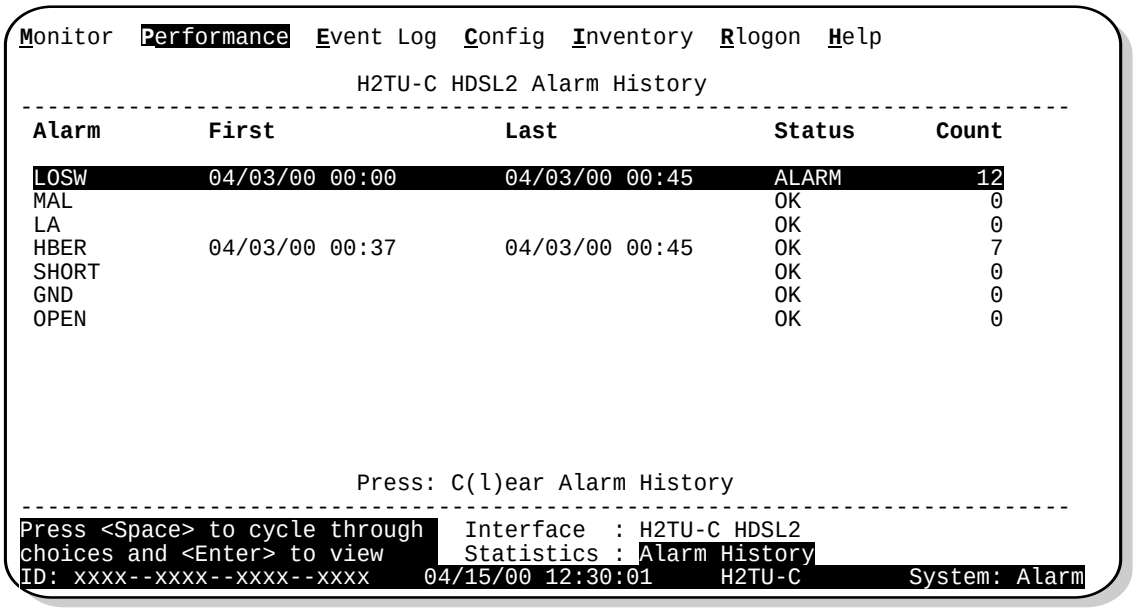


Figure 23. *H2TU-C HDSL2 Alarm History Screen*

Table 12. *HDSL2 Alarm Descriptions*

Screen Alarm	Front-Panel Alarm	Description
HDSL2 ALARMS at the H2TU-C and H2TU-R		
LOSW	LOSW	Loss of Sync Word—The HDSL2 loop has lost synchronization.
MAL	MAL	Margin—The margin on the HDSL2 loop has dropped below the minimum threshold value set for the system.
LA	LA	Loop Attenuation—The attenuation on the HDSL2 loop has exceeded the maximum value set for the HDSL2 loop attenuation threshold.
HBER	HBER	Block Error Rate—The HDSL2 BER has exceeded the set threshold limits of 10^{-6} or 10^{-7}.
HDSL2 ALARMS at the H2TU-C only		
SHORT	PWR FEED SHRT	Indicates a short between the Tip and Ring of the HDSL2 pair.
GND	PWR FEED GND	The HDSL2 loop is grounded.
OPEN	PWR FEED OPEN	Indicates a line power open condition.

USING THE EVENT LOG TO TRACK SYSTEM EVENTS

To view a running log of system events, press **E** to select the Event Log. The Event Log displays the date and time of the 100 most recent events (most recent displayed first) and provides a description of each event. Refer to Table 13 on page 35 for a complete list of event log messages.

- Press **N** or **P** to page through the event log.
- Press **T** to return to the top of the log.
- Press **L** to clear the event log.

```
Monitor  Performance  Event Log  Config  Inventory  Rlogon  Help

                        System Event Log (Page 1 of 7)
-------------------------------------------------------------------------------
#   Location        Date and Time         Entry

1   System          04/15/00 12:25:00     DS1 Alarm Register reset
2   System          04/15/00 12:25:00     HDSL2 Alarm Register Reset
3   System          04/15/00 12:25:00     DS1 Performance Register Reset
4   System          04/15/00 12:25:00     HDSL2 Performance Register Reset
5   System          04/15/00 00:13:32     Time set 12:25:00
6   System          04/15/00 00:13:27     Date set 04/15/00
7   H2TU-C          04/03/00 00:13:27     NLOC: Loop-down
8   H2TU-C          04/03/00 00:11:16     NLOC: Loop-up
9   H2TU-R          04/03/00 00:10:43     DS1 LOS Alarm: End
10  H2TU-R          04/03/00 00:10:30     DS1 LOS Alarm: Begin
11  System          04/03/00 00:04:11     DS1C: AUTO to AMI
12  H2TU-C          04/03/00 00:00:40     HDSL2 LOSW Alarm: End
13  H2TU-C          04/03/00 00:00:02     HDSL2 LOSW Alarm: Begin
14  - Empty -
15  - Empty -

        Press: (N)ext Page, (P)revious Page, (T)op of Log, C(l)ear Log
ID: xxxx--xxxx--xxxx--xxxx    04/15/00 12:30:01     H2TU-C        System: OK
```

Figure 24. *System Event Log*

Table 13. *Event Log Entry Messages List*

Event Log Messages
Any DS1 Alarm History reset
Any DS1 PM register reset
Any HDSL2 Alarm History reset
Any HDSL2 PM register reset
Any Loop Down (any segment)
Any Loop Up (any segment)
Any provisioning option change: <provisioning mnemonic>: changed from <old> to <new>
CPE DBER alarm (1 day threshold crossed of any PM data except PRM-NE or PRM-FE)
CPE DS1 AIS begins / ends
CPE DS1 LOS begins / ends
CPE PRM-NE BER alarm (*at the remote only*: 1 day threshold crossed of PRM-NE: trouble on CPE receive)
Current statistics reset
Event Log reset
H2TU-C Power up / down
H2TU-R Power up / down
HDSL2 DC pair open begins/ends on any segment
HDSL2 Ground fault begins/ends on any segment
HDSL2 HBER alarm (threshold crossed) on any segment.
HDSL2 loop attenuation (threshold crossed) on any HDSL2 I/F
HDSL2 margin alarm (threshold crossed) on any HDSL2 I/F
HDSL2 unavailability begins / ends on any segment
Master zero reset
NTWK DBER alarm (1day threshold crossed of any PM data)
NTWK DS1 LOS begins / ends
NTWK PRM-FE BER alarm (*at the remote only*: 1 day threshold crossed of PRM-FE: trouble on NTWK far end)
NTWN DS1 AIS begins / ends
Power Feed Open begins / ends
Power Feed Short begins / ends
RAI begins / ends
LRAI begins / ends (RAI-CI sent from the remote towards the network)

TESTING

This section provides information about front-panel system alarms, LOS and AIS response, OCT55 test procedure, and loopback testing.

FRONT-PANEL SYSTEM ALARMS

Table 14 summarizes all possible HiGain system alarms in order of priority as they appear on the front panel. When multiple alarms occur, the front-panel display only reports the highest priority alarm. The alarm history screens display alarms also, but provide greater detail. See "Using the Performance Screens to View Alarm Data" on page 30. All alarms that are not inhibited will drive the front-panel Status LED to a flashing red alarm state.

Table 14. *Front-Panel System Alarms Summary*

Front-Panel Message [a]	Alarm	Description	To Inhibit
PWR FEED SHRT [b]	Power Feed Short	A short exists between the Tip and Ring of the HDSL2 pair.	Cannot be inhibited.
PWR FEED GND [b]	Power Feed Ground	The HDSL2 loop is grounded.	Cannot be inhibited.
PWR FEED OPEN [b]	Power Feed Open	A line power open condition exists.	Cannot be inhibited.
LOSW [c]	Loss of Sync Word [d]	The HDSL2 loop has lost synchronization.	Cannot be inhibited.
LLOS [c]	Local Loss of Signal	Loss of the DSX-1 input signal.	Cannot be inhibited.
RLOS [c]	Remote Loss of Signal	Loss of the H2TU-R DS1 input signal.	Disable the RDA (Remote Disconnect Alarm) option. The front-panel Status LED still flashes red and the ALRM RLOS message displays to alert you of the LOS state. LOS is sent towards the network from the H2TU-C. This option prevents the common occurrences of a CPE LOS condition from generating recurring alarms and AIS payloads.
LAIS	Local Alarm Indication Signal	Indicates an AIS (all ones) pattern is being transmitted from the local DS1 output port.	Cannot be inhibited.
RAIS	Remote Alarm Indication Signal	Indicates an AIS (all ones) pattern is being received at the H2TU-R DS1 input port.	Cannot be inhibited.
LRAI	Line RAI—Remote Alarm Indication at the H2TU-R (Net signal does not have errors.)	Indicates an RAI alarm (yellow) from the CPE with an error-free signal from the line unit or network.	Cannot be inhibited.
RRAI	Remote RAI—Remote Alarm Indication at the H2TU-R. (Net signal has errors.)	Indicates an RAI alarm (yellow) from the CPE with errors from the line unit or network.	Cannot be inhibited.
xxxx-DBER	DS1 Bit Error Rate	The DS1 BER has exceeded the set threshold limits of approximately 10^{-6}. (*xxxx* denotes either TUC or TUR. If TUC and TUR occur at the same time, then TUC displays.)	Select DIS for the DBER system option.

Continued

Table 14. *Front-Panel System Alarms Summary (Continued)*

Front-Panel Message [a]	Alarm	Description	To Inhibit
LOF	Loss of Frame	The DS1 input does not contain the ESF or SF frame pattern setting of the FRMG option.	Change FRMG option to AUTO or UNFR.
PRMF	Performance Report Messaging - Far End	Indicates H2TU-R PRM-FE BER threshold is exceeded.	Set DBER threshold to DIS.
PRMN	Performance Report Messaging - Near End	Indicates H2TU-R PRM-NE BER threshold is exceeded.	Set DBER threshold to DIS.
xxxx-HBER [c]	HDSL2 Block Error Rate	The HDSL2 BER has exceeded the set threshold limits of 10^{-6} or 10^{-7}. (*xxxx* denotes either TUC or TUR. If TUC and TUR occur at the same time, then TUC displays.)	Select NONE for the HBER system option.
xxxx-MAL [c]	Margin Alarm	The margin on the HDSL2 loop has dropped below the minimum threshold value set for the system. (*xxxx* denotes either TUC or TUR. If TUC and TUR occur at the same time, then TUC displays.)	Set the Margin Alarm Threshold option to 0 (zero).
xxxx-LA [c]	Loop Attenuation	The attenuation on the HDSL2 loop has exceeded the maximum value set for the HDSL2 loop attenuation threshold. (*xxxx* denotes either TUC or TUR. If TUC and TUR occur at the same time, then TUC displays.)	Set the HDSL2 Loop Attenuation Threshold option to zero.

(a) The message, ALRM, displays prior to any alarm message.
(b) Message displays repeatedly as long as the alarm condition exists and is not included in the priority order.
(c) Only these alarms assert the System Alarm bus on pins 20 and 21 of the card-edge connector if the ALM option is enabled.
(d) When the HDSL2 loop loses sync word (LOSW), a system alarm condition exists. However, since the H2TU-C-388 enters the acquiring mode, the front-panel status LED flashes red, and the ACQ or SIG message displays instead of the ALRM message.

Alarm Option for DLC Feed

To improve HiGain compatibility with the switch-to-protect features used in DLC feeder applications, the H2TU-C-388 List 1 has an Alarm Pattern (ALMP) option that allows you to select either an AIS or LOS DS1 output payload for the following alarms:

- LOSW on any loop
- LOS DS1

Retiring System Alarms

To retire a system alarm, press the SEL button to execute an Alarm Cutoff (ACO). An ACO turns the alarm off and replaces the ALRM message with an ACO message. The second part of the ALRM message, which defines the cause of the alarm, remains. Both parts of the message remain until the alarm condition clears or another higher priority alarm occurs.

Remote LOS and AIS Response

Figure 25 shows the different ways the H2TU-R can respond to the network, depending on the configuration of the TLOS, NLBP, RDA, and ALMP configuration options described in Table 5 on page 17 and Table 6 on page 18.

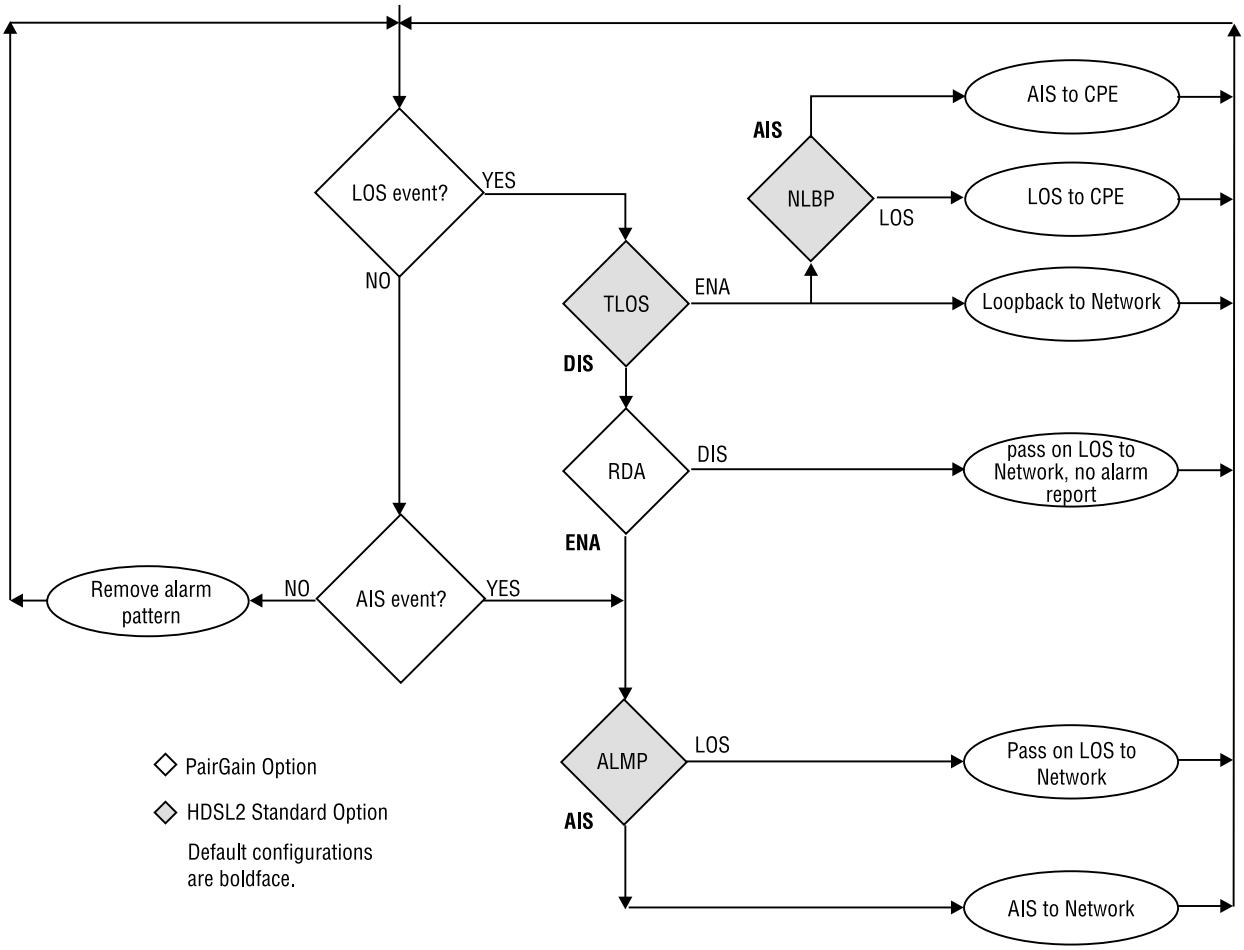


Figure 25. *H2TU-R LOS and AIS Response Priorities*

OCT55 Test Pattern with AMI Line Code

The OCT55 test pattern can be used in unframed mode to stress the system and verify data integrity. In an SF or ESF framing mode, excessive zero anomalies may occur, which causes the H2TU-C to report ES, SES and UAS errors according to ANSI T1.231-1997.

LOOPBACK OPERATION

HiGain has a family of loopback options for analyzing circuit functionality. The loopback signal is transmitted and returned to the sending device for comparison. This allows you to verify the integrity of the HDSL2 channels to the H2TU-C, the H2TU-C DSX-1 interface, and the DS1 channels to the customer. Loopback options include:

- Generic Loopback (GNLB) options, including the SmartJack (SMJK) option (see Table 15 on page 40)
- Special Loopback (SPLB) options (see "Special Loopback Commands" on page 41) and the following command tables:
  - Addressable Repeater Loopback commands: A1LB, A2LB, A5LB (see Table 16 on page 45)
  - Addressable Repeater Loopback commands: A3LB, A4LB (see Table 17 on page 47)

Loopback commands can be initiated by:

- Selecting the loopback type using the MODE and SEL buttons on the H2TU-C front panel (or the Manual Loopback button on the H2TU-R)
- Selecting the loopback type from the Monitor Menu when connected to the craft port of the H2TU-C or H2TU-R
- Entering the loopback code (exceptions are COLB, D*x*LB, and RULB) into the test equipment connected to the H2TU-C or H2TU-R

HiGain supports multiple loopbacks, but a single loopback is the preferred method.

Generic Loopback Commands

The HiGain Generic Loopback (GNLB) commands allow you to use inband codes to loop up either NLOC (4-in-7) or NREM (3-in-7) towards the network. In addition, these inband codes loop up CREM (6-in-7) or CLOC (5-in-7) towards the customer. Either loopup condition can be terminated (looped down) with the 3-in-5, SMJK loopdown code. All inband codes must be present for at least 5 seconds before the HiGain system responds. TLOS is a logic loopback caused by loss of the DS1 input from the CI.

Figure 26 summarizes the available loopbacks in the system, and Table 15 on page 40 summarizes the HiGain generic loopback commands. See "GNLB Test Procedures" on page 43 for the test procedures that apply when using the GNLB mode.

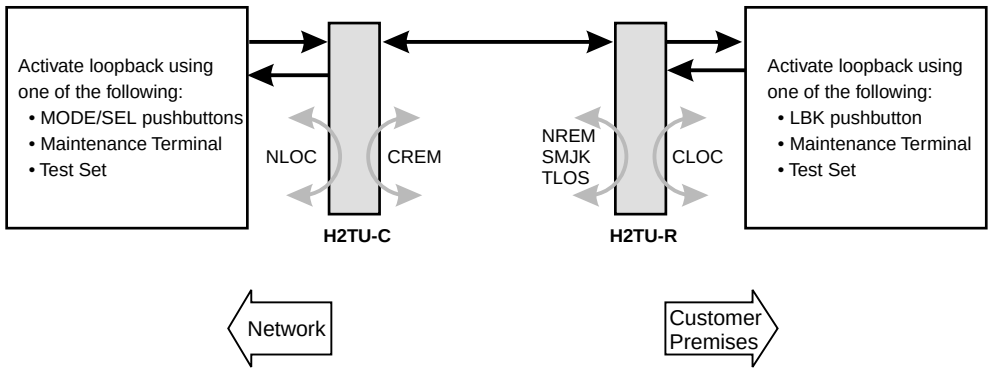


Figure 26. *Loopback Summary*

Table 15. *Summary of HiGain Loopback Codes and Activation Methods*

			Method of Activation		
Loopback	**Code**	**Description**	**Test Set**	**Craft Port**	**MODE/SEL**
NLOC	1111000 4-in-7	DSX-1 signal is looped back to the network at the H2TU-C.	X	X	X
NREM	1110000 3-in-7	DSX-1 signal is looped back to the network at the H2TU-R.	X	X	X
CLOC	1111100 5-in-7	Signal from the customer is looped back to the customer at the H2TU-R.	X	X	X
CREM	1111110 6-in-7	Signal from the customer is looped back to the customer at the H2TU-C.	X	X	X
COLB		Dual loopback at the H2TU-C. DSX-1 signal is looped back to the network at the H2TU-C and signal from the customer is looped back to the customer at the H2TU-C.		X	X
RULB		Dual loopback at the H2TU-R. DSX-1 signal is looped back to the network at the H2TU-R and signal from the customer is looped back to the customer at the H2TU-R.		X	X
SMJK LpUp (PL)	11000 2-in-5	SmartJack Loopup or NID payload (PL) code. Invokes H2TU-R loopback towards network.	X		
SMJK LpUp (ESF-DL)	1111-1111-0100-1000	SmartJack Loopup or NID (ESF-DL) code. Invokes H2TU-R loopback towards network.	X		
SMJK LpDn (PL)	11100 3-in-5	SmartJack Loopdown or NID payload (PL) code. Removes SMJK, NLOC, NREM, CLOC, CREM, CRG*x*, and NRG*x*.	X		
SMJK LpDn (ESF-DL)	1111-1111-0010-0100	SmartJack Loopdown or NID (ESF-DL) code. Removes SMJK, NLOC, NREM, CLOC, CREM, CRG*x*, and NRG*x*.	X		

HiGain systems feature the SmartJack option which can emulate a Network Interface Device (NID) for the purpose of loopback testing of the HiGain circuit. SMJK and NREM loopbacks perform the same functions, but their initiation differs. SMJK indicates that the loopback was initiated by the 2-in-5 inband command. NREM, on the other hand, is initiated by the 3-in-7 inband command or by a command issued from the maintenance terminal or the MODE and SEL buttons.

Use the inband commands to enable or disable the SMJK loopback options. The H2TU-C-388 system setting is normally enabled to recognize all inband SmartJack loopback commands.

Special Loopback Commands

In addition to the GNLB loopback command mode, a HiGain system can be configured for one of five special loopback command modes. These are selected from the maintenance terminal System Settings screen (see Table 5 on page 17) or by using the MODE and SEL buttons (see Figure 27 on page 44). Once a loopback mode is activated, other loopback commands can be sent by a test set connected to the craft port of the H2TU-C or H2TU-R (see Table 16 on page 45 and Table 17 on page 47 for list of SPLB commands).

A1LB through A5LB are five special, addressable, repeater loopback modes which are supported by the H2TU-C-388 List 1. These loopback modes provide the HiGain system with sophisticated maintenance and troubleshooting tools. A1LB, A2LB, and A5LB are patterned after the Teltrend addressable DS1 repeater loopbacks. A3LB and A4LB are patterned after the Wescom addressable DS1 repeater loopbacks. All five SPLBs have been enhanced to handle the specific requirements of the following HiGain customers:

- A1LB (Teltrend) = Southwestern Bell
- A2LB (Teltrend) = Southwestern Bell
- A3LB (Wescom) = New England Telephone
- A4LB (Wescom Mod 1) = New York Telephone
- A5LB (Teltrend Mod 1) = Southern New England Telephone (SNET), Southwestern Bell, Pacific Bell

The A1LB loopback selection complies with that proposed for HDSL2 systems in the T1E1.4/92 recommendation with the following additions:

- Query loopback
- IOR (Intelligent Office Repeater) powerdown
- Four loopback time-out choices
- Initiation from either end
- Repeating bit error signatures
- Alternate query loopback

These additions make A1LB identical to A2LB. A1LB is given a separate identity to allow future DS1/E1 enhancements to be added without affecting A2LB.

A5LB differs from A2LB in that A5LB does not block the arming code from exiting the H2TU-C-388 into the network. A1LB and A2LB can be configured to do one of the following:

- Block the arming code (after 2 seconds) from exiting the H2TU-C into the network, and replace it with the AIS code.
- Unblock the AIS code by executing the Far-End Activate code. (Since A5LB never blocks the arming code from exiting the H2TU-C, the Far-End Activate code is not available in A5LB.)

A3LB differs from A4LB in that A3LB supports the additional (1-in-6) SMJK loopback command.

Manual Loopback Session

A manual loopback session allows you to select any one of the HiGain loopbacks listed in Table 15 on page 40 with the exception of SmartJack loopbacks, which can only be issued by inband commands.

Setting the Loopback Time-out Option

Before initiating a loopback session, verify that the Loopback Time-out parameter is set to the desired setting.

1 Use the MODE and SEL buttons as described in "Setting Options through MODE and SEL" on page 9.

(The Loopback Time-out parameter is also user-selectable from the System Settings screen when using a maintenance terminal.)

2 Select the desired setting:

- NONE (time-out disabled)
- 20 minutes
- 60 minutes (default setting)
- 120 minutes

Activating Manual Loopback Mode

With the exception of SmartJack, any of the HiGain loopbacks can be executed using the MODE and SEL buttons.

When executing a manual loopback session using the MODE and SEL buttons:

- **The next loopback option can be displayed by pressing the MODE button, however, the previously activated loopback remains active until the SEL button is pressed, which activates the new loopback.**
- **If neither button is pressed for a period of 30 seconds and no loopback is in effect, the manual loopback session terminates and the display returns to normal mode.**
- **If any loopback is in effect, the 30-second time-out is inhibited. The active loopback and the manual loopback session continue until the loopback times out in accordance with the LBTO setting.**
- **If there is an active loopback, pressing the MODE and SEL buttons for 3 or more seconds terminates any active loopback, ends the manual loopback session, and returns the display to normal mode.**

To initiate a manual loopback session:

1 Press both the MODE and SEL buttons on the front panel for at least 5 seconds. The following message appears on the front-panel display:

`MAN LPBK NLO?`

2 Press SEL to activate NLOC. The display changes to `MAN LPBK NLOC`.

3 Press MODE to advance to the next available loopback:

- NRE? = NREM
- CRE? = CREM
- CLO? = CLOC
- COL? = dual loopback at H2TU-C.
- RUL? = dual loopback at H2TU-R.

4 Press SEL to activate the selected loopback. The previous loopback is terminated.

Once a loopback is selected and activated, the loopback stays active until it times out (based on the LBTO setting). When a loopback times out, the display then returns to the normal display mode.

You can terminate loopbacks manually and exit the MAN LPBK mode by simultaneously pressing the MODE and SEL buttons for 3 or more seconds. If no loopback is active, the MAN LPBK mode automatically terminates after 30 seconds.

All loopbacks (except dual loopbacks) can be initiated by inband commands in the DS1 payload. Loopbacks can also be initiated by a command from the HiGain system (front-panel buttons or maintenance screen selections). Therefore, whenever a loopback is active, the method by which it was activated is indicated in the Loopback and Status screens by the annotation HG or PL adjacent to the identified loopback. For example, NREM-HG indicates that the loopback was initiated by the HiGain system.

SMJK loopback commands are only activated by inband commands. Dual loopback commands are only activated by the front-panel buttons or maintenance screen selections.

LOOPBACK TEST PROCEDURES

The following sections provide step-by-step test procedures for verifying the integrity of the HDSL2 channels at every module location as well as the DS1 channels to the customer and the local DSX-1 interface.

General Troubleshooting Tips

If trouble is encountered on the DSX-1 interface of the H2TU-C-388, verify that the:

- H2TU-C is making a positive connection with its mounting-assembly (shelf) connector.
- H2TU-C internal equalizer is set to the correct distance range per Table 5 on page 17. All equalizers should be set to the distance from the DSX-1 to the shelf.

The transmit and receive DSX-1 ports have splitting access jacks and miniature, 210-series, monitor jacks as shown in Figure 1 on page 3. Connecting one cable between the two monitoring jacks and another between the two LINE jacks splits the IN and OUT and creates metallic loopbacks towards both the DSX-1 and the H2TU-C-388. If separate plugs are inserted into both LINE jacks with the other end disconnected, the MON jacks can be used to send and receive test patterns towards the DSX-1.

GNLB Test Procedures

Figure 27 on page 44 is a graphical representation of the various loopback configurations with the associated GNLB commands shown. Also, refer to Table 15 on page 40 for a description of these commands.

To perform the GNLB loopback test procedure:

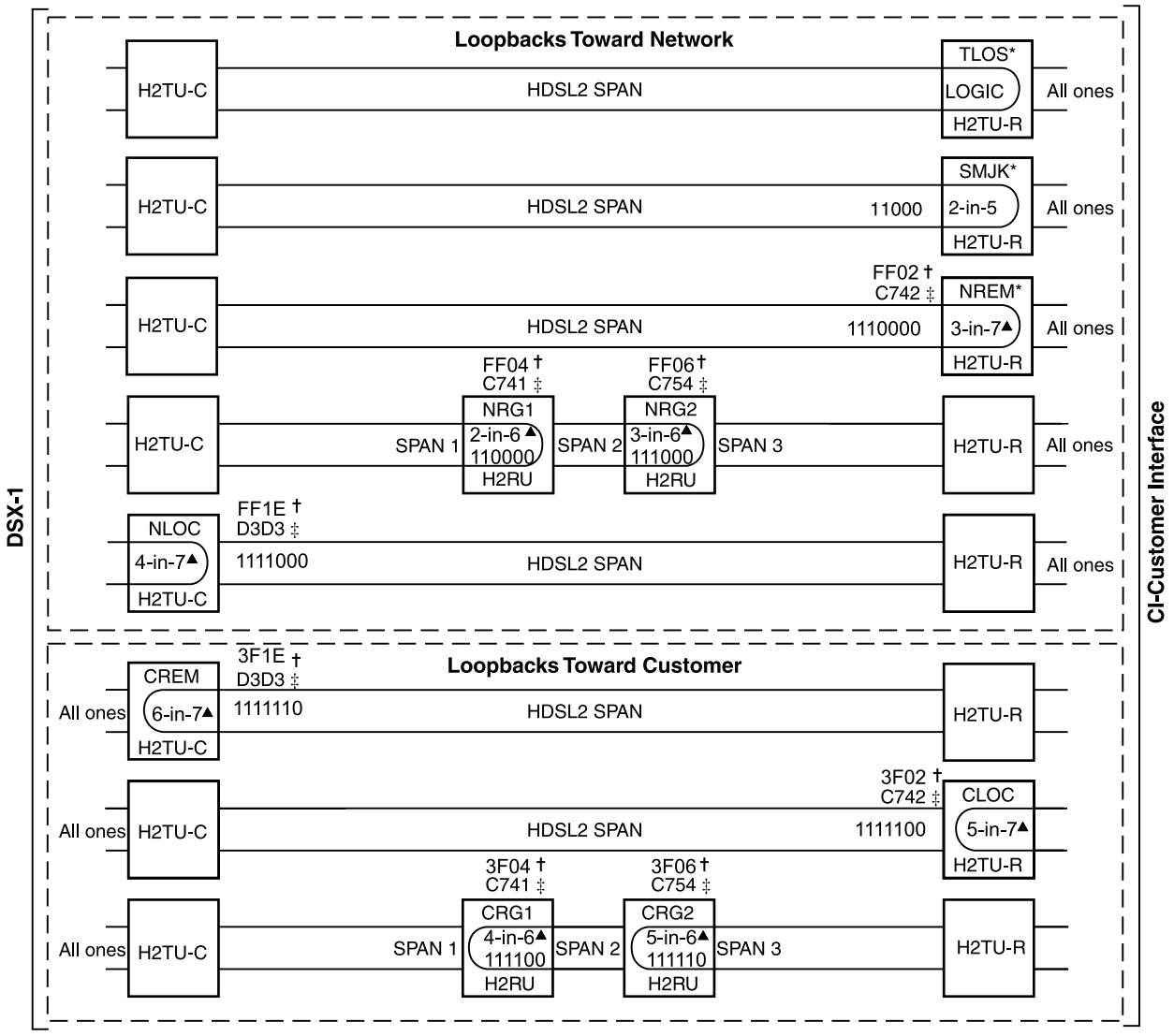
1 Have the CO tester send the NREM (3-in-7) inband loopup code for 5 seconds. You should be able to observe the NREM message on the front-panel display. (The Status LED on the front panel should be green, and the loopback mode should also be identified on the Span Status screen.)

2 Have the CO tester transmit a DS1 test signal towards the H2TU-C-388 and verify that the returned (looped) signal to the test set is error-free.

3 If step 2 fails, have the CO tester transmit the 3-in-5 inband loopdown code.

4 Have the CO tester send the NLOC (4-in-7) inband loopup for 5 seconds. You should be able to observe the NLOC message on the front-panel display. (The Status LED on the front panel should be yellow, and the loopback mode should also be identified on the Span Status screen.)

5 Repeat Step 2. If the test passes, the problem is in the downstream direction. If it fails, the problem is in the upstream direction.



* Set the NLBP option to AIS to send AIS (indicated by an all ones pattern) for any network loopback.

† A3LB and A4LB loopback codes.

‡ A1LB, A2LB, and A5LB loopback codes.

▲ GNLB loopback codes.

Figure 27. *Loopback Modes*

A1LB, A2LB, and A5LB Test Procedures

Using the codes listed in Table 16, a network tester can activate NLOC, NRG or NREM loopbacks (or SMJK, if enabled). A tester at the customer premises can activate CLOC, CRG, or CREM loopbacks. All loopbacks shown in Table 16 can also be initiated from the H2TU-C-388 front-panel MODE and SEL buttons (see "Setting Options through MODE and SEL" on page 9).

Table 16. *Addressable Repeater Loopback Commands (A1LB, A2LB, A5LB)*

Name	Description	Binary Code [a] (Hexadecimal Equivalent)
ARMING or NI LPBK (inband)	Arming code	11000-11000 ...
ARMING or NI LPBK (ESF Data Link)	Arming code	1111-1111-0100-1000 (FF48)
IR LPDN or DISARM (inband)	Disarming code	11100-11100 ...
IR LPDN or DISARM (ESF Data Link)	Disarming code	1111-1111-0010-0100 (FF24)
IOR LPBK (NLOC and CREM) 230-232 bit errors 229-231 bit errors [b]	H2TU-C loopup	1101-0011-1101-0011 (D3D3)
IR LPDN	Loopdown (H2TU-C, H2RU, or H2TU-R)	1001-0011-1001-0011 (9393)
IR QUERY LPBK	Query loopback	1101-0101-1101-0101 (D5D5)
IR ALTERNATE QUERY LPBK	Alternate query loopback	1101-0101-1110-1010 (D5EA)
TIME-OUT OVERRIDE	Loopback time-out override	1101-0101-1101-0110 (D5D6)
FAR-END NI ACTIVATE [c]	Unblock AIS	1100-0101-0101-0100 (C554)
IOR POWER DOWN (H2TU-C) [d]	Removes HDSL2 line power	0110-0111-0110-0111 (6767)

(a) The leftmost bit arrives first in all sequences. The detection algorithm functions reliably with a random 10^{-3} BER on the facility. The entire arming and loopback sequence can also be initiated at the remote H2TU-R location.

(b) The H2TU-R identifies CREM (and the H2TU-C identifies NLOC) with 231 bit errors, including the frame bits. When framed data is being sent in the Auto framing mode, the number of the 231 bit errors detected by the test set varies from 229 to 231, depending on whether or not the test set counts frame errors as bit errors and on the number of frame bits contained in the block of 231 error bits. The H2TU-R and H2TU-C generate this bit pattern in a series of discontinuous bursts containing 20-bit errors each, including frame bits. Those test sets that do not count frame error bits as data bit errors will indicate fewer bits than the H2TU-R and H2TU-C transmit for a CI and NI loopback.

(c) Sending the Far-End NI Activate code is not required in A5LB because it is always activated.

(d) The IOR Power Down code must remain present for the duration of the powerdown mode. When this code is removed, the HiGain system returns to its normal unlooped and unarmed state.

To perform the A1LB, A2LB, and the A5LB test procedures:

1 Send the inband Arming and NI LPBK code 11000 to the H2TU-C-388 for at least 5 seconds.

2 Monitor the output of the H2TU-C-388 for the return of the pattern. Return of the pattern indicates one of the following:

- the H2TU-R has looped up (if the SMJK Loopback option is enabled)
- an external NID has looped up (if the SMJK Loopback option is disabled), and the H2TU-C and H2TU-R have been armed.

3 Verify, if possible, that the H2TU-R Loopback LED is either flashing yellow at 4 times per second (indicating that the system is armed), or is a steady yellow (indicating that it is both armed and in SMJK loopback). The H2TU-C Status LED also flashes yellow when the system is armed.

If the Arming code is not returned after 5 seconds, the system may be armed but there is no active loopback.

4 Once armed, the H2TU-C-388 can be looped back by sending Intelligent Office Repeater (IOR) LPBK activation code 1101-0011-1101-0011 (D3D3) for at least 5 seconds. You should observe the following activation response pattern in the order presented:

a 2 seconds of AIS (all ones pattern)

b 2 seconds of returning data pattern

c Logic errors (including the frame bit) occurring in the returned pattern comprising:

– 231 errors, if IOR LPBK (H2TU-C-388) was sent

– 20 errors, if ILR-2 (H2TU-R) was sent

d normal looped data

This error pattern repeats every 20 seconds as long as the IOR loopback pattern is being sent. This also applies to ILR, Time-out Override, and Query commands.

The H2TU-C is now in logic loopback if the IOR NLOC loopback command was sent. The Time-out Override command or a Loopdown command can override the selection made for the loopback time-out (see "Setting the Loopback Time-out Option" on page 42). If the Time-out Override code 1101-0101-1101-0110 (D5D6) is received after activating a loopback, then the automatic timed expiration of the loopback is inhibited. If this Time-out Override is sent, then the only way to loop the H2TU-C-388 down is to do one of the following:

- issue the Intelligent Repeater (IR) loopdown (LPDN) code 1001-0011-1001-0011 (9393)
- issue the NI LPDN and Disarm inband code 11100 or the ESF-DL code (FF24).

The Time-out Override function is only valid for the current active loopback. The automatic time-out timer is restored during subsequent loopback sessions.

5 Once the test is complete, do one of the following:

- If the system is to loop down but remain Armed, send the IR LPDN code.
- If all the equipment is to be looped down, disarmed, and returned to normal operation, send the disarm inband code 11100 or the ESF-DL code (FF24).

The Armed mode has an automatic time-out of 60 minutes but this timer is reset to 60 for any of the following events:

- **Loopback terminates (manually or time-out)**
- **Query**
- **Alternate query**
- **Far End activate**
- **Another ARM command**

This timer is inhibited while any of the valid command codes are being sent. Once the codes are removed, the timer restarts at 60.

A3LB and A4LB Test Procedures

The H2TU-C-388 can be looped back by sending the Addressable Office Repeater (AOR) LPBK activation code 1111-1111-0001-1110 (FF1E) for at least 5 seconds. This causes the H2TU-C-388 to enter the NLOC state. The Loopback Time-out setting (see "Setting the Loopback Time-out Option" on page 42) determines the duration of this loopback unless it is overridden by the reception of a second identical 16-bit loopup command before the timer expires. When this time-out override state exists, the only way to loop the H2TU-C-388 down is to issue one of the three loopdown commands listed in Table 17. The automatic time-out mode is restored during subsequent loopback sessions.

Table 17 summarizes the codes required to execute Addressable 3 (A3LB) and Addressable 4 (A4LB) repeater loopback commands. All code sequences must be present for at least 5 seconds.

Table 17. *Addressable Repeater Loopback Commands (A3LB and A4LB)*

Name	Description	Binary Code [a] (Hexadecimal Equivalent)
NLOC	H2TU-C-388 loopup from NI	1111-1111-0001-1110 (FF1E)
CREM	H2TU-C-388 loopup from CI	0011-1111-0001-1110 (3F1E)
NREM	H2TU-R loopup from NI	1111-1111-0000-0010 (FF02)
CLOC	H2TU-R loopup from CI	0011-1111-0000-0010 (3F02)
SMJK	H2TU-R loopup from NI	11000-11000-11000 ...
SMJK	H2TU-R loopup from NI [b]	100000 100000 100000 ...
SMJK	H2TU-R loopup from NI (ESF-DL)	1111-1111-0100-1000 (FF48)
Loopdown	H2TU-C and H2TU-R loopdown from NI OR CI	11100-11100-11100 ...
Loopdown	H2TU-C and H2TU-R loopdown from NI OR CI	100-100-100 ...
Loopdown	H2TU-C and H2TU-R loopdown from NI OR CI (ESF-DL)	1111-1111-0010-0100 (FF24)

(a) The leftmost bit arrives first in all sequences. The detection algorithm functions reliably with a random 10^{-3} BER on the facility. The entire arming and loopback sequence can also be initiated at the remote H2TU-R location.
(b) Not supported by A4LB.

APPENDIX A - SPECIFICATIONS

Power	
Line Voltage	0, -185 Vdc
CO Supply	-48 Vdc nominal (-42.5 Vdc to -56.5 Vdc) (See "Power Consumption" and "Maximum Power Dissipation" and "Maximum Current Drain" on page 49.)
Electrical Protection	Secondary surge and power cross protection on HDSL2 ports. Requires external primary protection.
Fusing	Internal; connected to "FUSE ALARM" output on pin 117
Environmental	
Operating Temperature	-40 °F to +149 °F (-40 °C to +65 °C)
Operating Humidity	5% to 95% (non-condensing)
Physical	
Height	3.62 in. (9.2 cm)
Width	0.69 in. (1.8 cm)
Depth	10 in. (25.4 cm)
Weight	0.5 lbs. (.23 kg)
Mounting	DDM+ high-density shelf
HDSL2	
Line Rate	1.552 Mbps Overlapped Pulse Amplitude Modulation Transmission with Interlocking Spectra (OPTIS)
Transmission	Full duplex
Media	One non-loaded, copper, two-wire cable pair
Output	+16.8 dBm ±0.5 dB at 135 Ω (0-450 kHz) at CO side; +16.5 dBm ±0.5 dB at 135 Ω (0-350 kHz) at remote side
Line Impedance	135 Ω
Maximum Loop Attenuation	35 dB at 196 kHz, 135Ω
Start-up Time	30 seconds (typical), 1 minute (maximum)
DSX-1	
DSX-1 Line Impedance	100 Ω
DSX-1 Line Rate	1.544 Mbps ±200 bps
DSX-1 Line Format	Alternate Mark Inversion (AMI) or Bipolar with 8-Zero Substitution (B8ZS)
DSX-1 Frame Format	Extended SuperFrame (ESF), SuperFrame (SF), or Unframed (UNFR)
DSX-1 Pulse Output	6 $V^{pk\text{-}pk}$ pre-equalized for 0 to 655 feet of ABAM cable
DSX-1 Input Level	+1.5 to -7.5 dB DSX
System	
One-way DS1 Delay	<400 µs over the span
Wander (Looped)	Meets MTIE T1.101 requirements
Wideband Jitter (Looped)	0.2 UI maximum
Narrowband Jitter (Looped)	0.1 UI maximum

POWER CONSUMPTION

The maximum power consumption and heat dissipation depends upon the type of remote units in the system and the CPE power setting.

The three most important power parameters of an H2TU-C are its maximum power consumption, its maximum power dissipation and its maximum current drain.

Table 18 describes line-powered circuits on 9 kft, 26 AWG loops.

Table 18. *H2TU-C-388 Power Parameters*

	-48 Vdc Power Consumption (Watts)	Heat Dissipation (Watts)	-42.5 Vdc Current (mA)
Remote Power Source	**Maximum**	**Maximum**	**Maximum**
Line powered	12.5	7.0	294.0
Local powered	5.0	5.0	117.0

MAXIMUM POWER DISSIPATION

The maximum power dissipation measures the power that is converted into heat that builds up within the unit. It contributes to the total heat generated in the space around the unit. It is used to determine the maximum number of fully loaded shelves per bay that does not exceed the maximum allowable power dissipation density in watts per square foot to comply with GR-63.

In COs, the maximum power dissipation for open-faced, natural convection-cooled mountings is limited to 134.7 watts per square foot per GR-63-CORE. The footprint of a standard 28-slot, 23-inch HMS-317 shelf is 7.024 square feet. Therefore, the maximum bay dissipation is limited to 946 watts. Use this limit and the parameters in Table 18 to determine the maximum number of H2TU-C circuits that can occupy one CO bay.

This is a worst case situation since it assumes the entire CO is subjected to the maximum power density. More favorable conditions would permit increasing the number of shelves per bay without jeopardizing the CO thermal integrity.

The thermal loading limitations imposed when using the H2TU-C in a Controlled Environmental Vault (CEV) or other enclosures are determined by applying its power parameters to the manufacturer's requirements for each specific housing.

The -48 Vdc power consumption is the maximum total power that the H2TU-C-388 consumes or draws from the shelf power source. This parameter is needed when the H2TU-C-388 is in a location remote to the CO it is serving. It determines the battery capacity required to maintain an 8-hour, standby battery reserve for emergency situations. Battery capacity, therefore, limits the maximum number of line units which can be installed in a remote enclosure. Use the data in Table 18 to perform this analysis.

MAXIMUM CURRENT DRAIN

The maximum current drain is the maximum current drawn from the shelf power supply when it is at its minimum voltage (-42.5 Vdc). This determines the shelf fusing requirements. Use the -42.5 Vdc current data in Table 18 to determine the shelf fusing requirements for your particular H2TU-C applications.

LOOP ATTENUATION

Each loop has no more than 35 dB of loss at 196 kHz, with driving and terminating impedances of 135Ω (see Table 19 below).

Table 19. *HDSL2 Cable Attenuation Chart*

Cable Gauge	Loss at 196 kHz (dB/kft)	Ω per kft
26/0.4 mm	3.88	83
24/0.51 mm	2.84	52
22/0.61 mm	2.18	32
19/0.91 mm	1.54	16

HIGAIN LINE UNIT CARD-EDGE CONNECTOR

Figure 28 shows the card-edge connectors on the HiGain Line Unit. Active pins are highlighted in black.

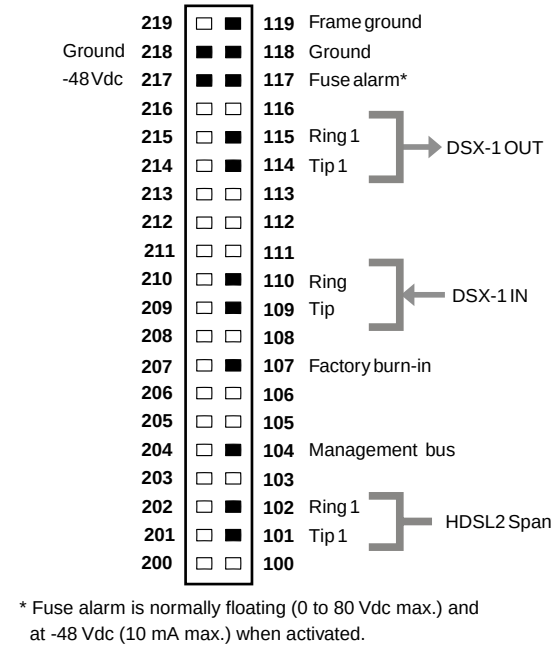


Figure 28. *HiGain Line Unit Card-Edge Connector*

Network Management Control Bus

The H2TU-C-388 provides a Network Management Control Bus on pin 104 of the card-edge connector. This allows the various ADC Management System protocols to manage the H2TU-C through the HMU-319 HiGain Management Unit. Whenever the H2TU-C-388 is under management, the `MNGD` message displays periodically on the front-panel display.

Some HiGain Line Unit features are affected when it is under management. Consult the management unit practice for further information.

Fuse Alarm

Pin 117 on the card-edge connector is a fuse alarm that is driven to -48 Vdc through a diode whenever its onboard fuse opens.

CRAFT PORT

Figure 29 shows the craft port adapter and its connection to a DB-9 or DB-25 connector on a maintenance terminal.

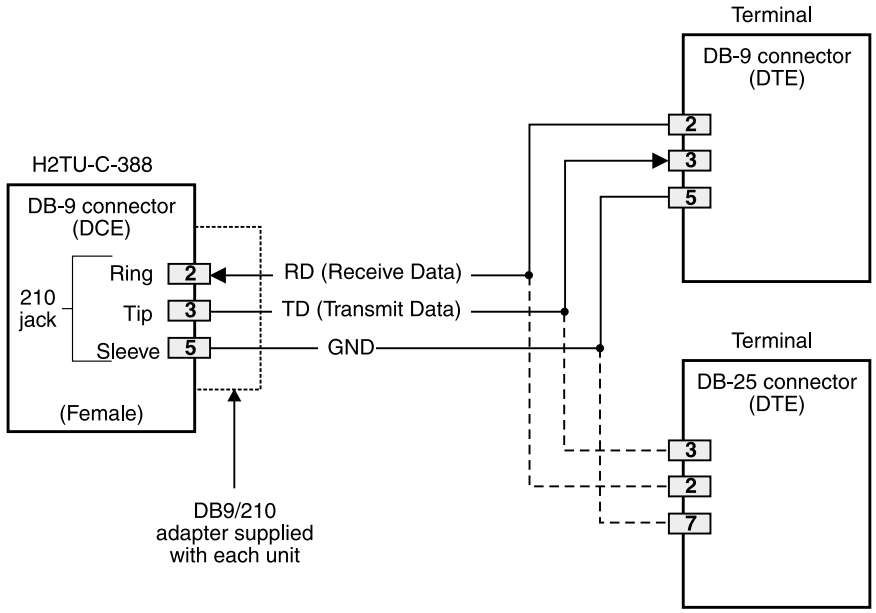


Figure 29. *210-to-DB-9 Adapter*

APPENDIX B - FUNCTIONAL OPERATION

ADC HDSL2 technology provides full-duplex services at standard DS1 rates over copper wires between an H2TU-C and an H2TU-R, which comprise one HiGain system. HiGain systems use ADC Overlapped PAM Transmission with Interlocking Spectra (OPTIS) transceiver systems to establish full-duplex, 1.552 kbps data channels between the H2TU-C-388 List 1 and a remotely located H2TU-R.

Figure 30 shows a block diagram of the H2TU-C-388 List 1. The H2TU-C-388 List 1 receives a 1.544 Mbps DSX-1 data stream from the DSX-1 digital cross connect interface. The H2TU-C-388 contains a DS1 frame synchronizer controlled by an 8-bit microprocessor that determines the type of framing on the DS1 stream and synchronizes to it. The H2TU-C-388 recognizes Superframe (SF), including D4, or Extended Superframe (ESF) framing.

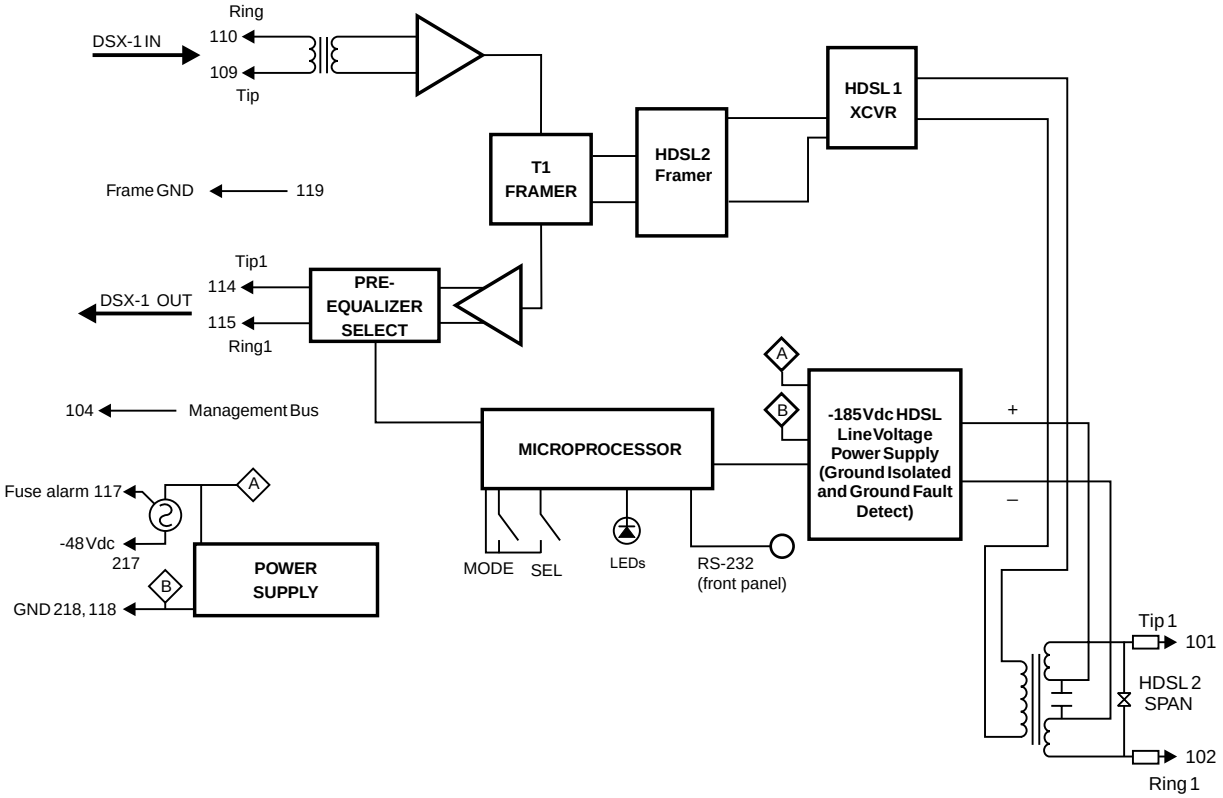


Figure 30. *H2TU-C-388 List 1 Block Diagram*

TIMING

The low loop wander (0.5 UI max) of an H2TU-C-388, when used with a compatible remote unit, allows the circuit to be used in all critical timing applications, including those that are used to transport Stratum 1 timing.

GROUND FAULT DETECT

The H2TU-C-388 has a Ground Fault Detect (GFD) circuit which detects a ground or a resistive path to ground on any wire of the HDSL2 loop. This makes the product compliant with the Class A2 requirements of GR-1089.

APPENDIX C - COMPATIBILITY

The HiGain system uses HDSL2 transmission technology as recommended by ANSI committee in compliance with the August 1999 T1-E1.4/99-006R5 HDSL2 standards.

The H2TU-C-388 List 1 is compatible with the following DDM+ high-density shelves and associated equipment:

- HCS-402, two-slot shelf with #150-1193-01 adapter
- Shelf (23-inch)
  - Larus FT2 1188 (28-slot, connectorized)
  - AT&T DS1 Ext. (28-slot, connectorized)
- Shelf (19-inch)
  - Larus FT21187 (20-slot, connectorized)
- Cabinet Distant Terminal (23-inch)
  - Larus FT2 1190 (12 slots) for a 51A cabinet.

APPENDIX D - PRODUCT SUPPORT

ADC Customer Service Group provides expert pre-sales and post-sales support and training for all its products.

Technical support is available 24 hours a day, 7 days a week by contacting the ADC Technical Assistance Center (TAC).

Sales Assistance 800.366.3891 extension 73000 (USA and Canada) 952.917.3000 Fax: 952.917.3237	• Quotation Proposals • Ordering and Delivery • General Product Information
Systems Integration 800.366.3891, extension 73000 (USA and Canada) 952.917.3000	• Complete Solutions (from concept to installation) • Network Design and Integration Testing • System Turn-Up and Testing • Network Monitoring (upstream or downstream) • Power Monitoring and Remote Surveillance • Service/Maintenance Agreements • Systems Operation
ADC Technical Assistance Center 800.638.0031 714.730.3222 Fax: 714.730.2400 Email: wsd_support@adc.com	• Technical Information • System/Network Configuration • Product Specification and Application • Training (product-specific) • Installation and Operation Assistance • Troubleshooting and Repair/Field Assistance
Online Technical Support	• www.adc.com/Knowledge_Base/index.jsp
Online Technical Publications	• www.adc.com/library1/
Product Return Department 800.366.3891 ext. 73748 or 952.917.3748 Fax: 952.917.3237 Email: repair&return@adc.com	• ADC Return Material Authorization (RMA) number and instructions must be obtained before returning products.
All 800 lines are toll-free in the USA and Canada.	

APPENDIX E - ABBREVIATIONS

A

ACO: Alarm Cutoff
AIS: Alarm Indication Signal
ALM: Alarm
AMI: Alternate Mark Inversion
AWG: American Wire Gauge

B

B8ZS: Bipolar with 8-Zero Substitution
B8ZSS: B8ZS Monitored Seconds
BER: Bit Error Rate
BPV: Bipolar Violation
BPVT: Bipolar Violation Transparency

C

CI: Customer Installation
CLEI: Common Language Equipment Identifier
CLOC: Customer Local Loopback
CO: Central Office
CPE: Customer Premises Equipment
CRC: Cyclical Redundancy Check
CREM: Customer Remote Loopback
CSA: Carrier Service Area
CV: Code Violation

D

DBER: DS1 Bit Error Rate
DDS: Digital Data Service
DLC: Digital Loop Carrier
DS1: Digital Signal, level 1
DSX-1: DS1 Cross-Connect Frame

E

ECI: Equipment Catalog Item ,
ES: Errored Seconds ,
ESD: Electrostatic Discharge
ESF: Extended SuperFrame
ES-L: Errored Seconds - Line
ES-P: Errored Seconds - Path

G

GNLB: Generic Loopback

H

H2TU-R: HiGain Remote Unit
HBER: HDSL2 Bit Error Rate
HCDS: High Capacity Digital Service
HCS: HiGain Card Shelf
HDSL2: High-bit-rate Digital Subscriber Line 2
HMS: HiGain Management Shelf
HMU: HiGain Management Unit

I

ID: Identification
ILR: Intelligent Line Repeater
IN: Transmit
IOR: Intelligent Office Repeater
IR: Intelligent Repeater

L

LA: Loop Attenuation ,
LED: Light Emitting Diode
LOS: Loss of Signal
LOSW: Loss of Sync Word
LOSWS: Loss of Sync Word Second
LPF: Line Power Feed

M

MSEC: Monitored Seconds

N

NI: Network Interface
NID: Network Interface Device
NLOC: Network Local Loopback
NMA: Network Management and Administration
NREM: Network Remote Loopback
NVRAM: Non-Volatile Random Access Memory

O

OPTIS: Overlapped PAM Transmission with Interlocking Spectra

OUT: Receive

P

PAM: Pulse Amplitude Modulation
PRM-FE: Performance Report Messaging - Far End
PRM-NE: Performance Report Messaging - Near End
PWRF: Power Feed

R

RDA: Remote Disconnect Alarm
RLOS: Remote Loss of Signal

S

SES: Severely Errored Seconds ,
SES-L: Severely Errored Seconds - Line

SES-P: Severely Errored Seconds - Path
SF: SuperFrame
SMJK: SmarkJack
SPLB: Special Loopback

T

TLOS: Transmit Loss of Signal

U

UAS: Unavailable Seconds

CERTIFICATION AND WARRANTY

FCC CLASS A COMPLIANCE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

LIMITED WARRANTY

ADC DSL Systems, Incorporated (“ADC”) warrants that, for a period of sixty (60) months from the date of shipment, the hardware portion of its products will be free of material defects and faulty workmanship under normal use. ADC's obligation, under this warranty, is limited to replacing or repairing, at ADC's option, any such hardware product which is returned during the 60-month warranty period per ADC's instructions and which product is confirmed by ADC not to comply with the foregoing warranty.

ADC warrants that, for a period of 90 days from the date of purchase, the software furnished with its products will operate substantially in accordance with the ADC published specifications and documentation for such software. ADC’s entire liability for software that does not comply with the foregoing warranty and is reported to ADC during the 90-day warranty period is, at ADC’s option, either (a) return of the price paid or (b) repair or replace of the software. ADC also warrants that, for a period of thirty (30) days from the date of purchase, the media on which software is stored will be free from material defects under normal use. ADC will replace defective media at no charge if it is returned to ADC during the 30-day warranty period along with proof of the date of shipment.

The transportation charges for shipment of returned products to ADC will be prepaid by the Buyer. ADC will pay transportation charges for shipment of replacement products to Buyer, unless no trouble is found (NTF), in which case the Buyer will pay transportation charges.

ADC may use reconditioned parts for such repair or replacement. This warranty ***does not*** apply to any product which has been repaired, worked upon, or altered by persons not authorized by ADC or in ADC's sole judgment has been subjected to misuse, accident, fire or other casualty, or operation beyond its design range.

Repaired products have a 90-day warranty, or until the end of the original warranty period—whichever period is greater.

ADC DISCLAIMS ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WITH RESPECT TO ITS PRODUCTS AND ANY ACCOMPANYING WRITTEN MATERIALS. FURTHER, ADC DOES NOT WARRANT THAT SOFTWARE WILL BE FREE FROM BUGS OR THAT ITS USE WILL BE UNINTERRUPTED OR REGARDING THE USE, OR THE RESULTS OF THE USE, OF THE SOFTWARE IN TERMS OF CORRECTNESS, ACCURACY, RELIABILITY OR OTHERWISE.

MODIFICATIONS

Any changes or modifications made to this device that are not expressly approved by ADC DSL Systems, Inc. voids the user's warranty.

All wiring external to the products should follow the provisions of the current edition of the National Electrical Code.

SAFETY STANDARDS COMPLIANCE

The H2TU-C-388 modules have been tested and verified to comply with the applicable sections of the following safety standards:

- GR 63-CORE - Network Equipment-Building System (NEBS) Requirements
- GR 1089-CORE - Electromagnetic Compatibility and Electrical Safety
- UL-1459, 3rd Edition and CSA C22.2 225-M90: Telecommunications Equipment – Electronics and Electrical Safety

For technical assistance, refer to “Appendix D - Product Support” on page 54.

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